RESEARCH REPORT

QUALITY BY DESIGN
A QUALITY ASSURANCE PROTOCOL FOR WOOD FRAME BUILDING ENVELOPES IN BRITISH COLUMBIA

JANUARY 25, 1999

CMHC SCHL

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Canada

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"Helping to House Canadians"

Quality by Design

a Quality Assurance Protocol
for Wood Frame Building Envelopes
in British Columbia

January 25, 1999

Applies to quality assurance in:
design, project and building site management,
construction, warranty and maintenance.
Based on ISO 9001: 1994

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Note:
This document outlines the proposed Quality Assurance Protocol and includes a generic Quality Manual. It refers to the Best Practices Guide and attached forms as appropriate.

CONTENTS

FOREWORD

Quality by Design was commissioned as the Quality Assurance Protocol by Canada Mortgage and Housing Corporation in order to establish a management system for the assurance of quality of the exterior of multi-storey wood frame buildings located in the coastal climate of British Columbia. This is part of the initiatives undertaken by the Building Envelope Research Consortium, of which CMHC is a prominent member, to address the "leaky condo" issue as it pertains to new construction

The Importance of *Quality by Design*

We believe the *Quality by Design* is important for these reasons:

- It brings together thinking about building envelope quality from a representative sample of all of the design and construction professionals who produce building envelopes;
- It is designed to be practical and usable;
- It is designed as a basis to be built onto by designers, builders, suppliers and installers of the building envelope. It is not exclusive nor does it exclude anyone involved in building envelopes from "buying in";
- It is based on a recognized international standard, ISO 9001:1994, which is a quality system standard likely to become prevalent in Canada in the next few years. Persons adopting the Protocol will find it eases their future adoption of ISO 9001;

Useful for any project

Although this Protocol is focused on the exterior of multi-srorey wood frame buildings, i.e., their "building envelope", it has been designed such that its use could be expanded to other building forms as well as to other aspects of design and construction practice. The Quality Manual portion of this Protocol will be available on disc to purchasers, allowing them to customize it to their needs

A major challenge in developing this Protocol was simply to define what it is and consists of. The first paragraph above provides as good a definition as any. As a minimum, the Protocol includes the following documents:

What is the Protocol?

1 This Introductory document;
2 The Quality Manual;
3 The Best Practices Guide;
4 Associated Forms.

Items 1 and 2 are specific products of our contract with CMHC. Item 3 is being developed concurrently by others and reviewed by us for integration with the Quality Manual. Item 4 has been introduced with the Quality Manual, however each adopter of the Quality Assurance Protocol will probably add to its content in association with the particulars of their building envelope involvement.

Since a Quality Assurance Protocol could include other elements, such as a company's Standard Operating Procedures, detailed Work Instructions, considerations of collective agreements, etc., it is perhaps best to envision the QAP as being a vessel to contain elements of a range of thinking, i.e.:

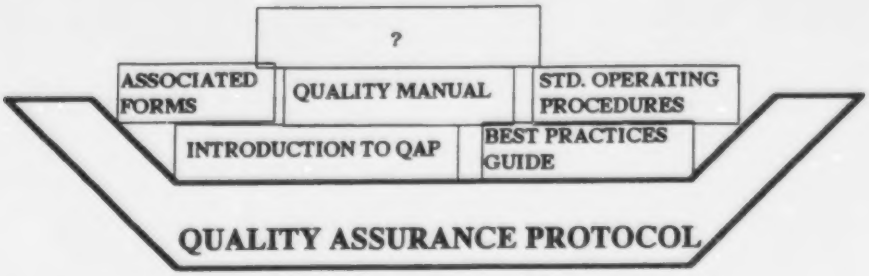

Figure F-1: The Quality Assurance Protocol

ACKNOWLEDGMENTS

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ISBN _____

INTRODUCTION AU PROTOCOLE D'ASSURANCE DE LA QUALITÉ (PAQ)

Qu'est-ce que le protocole d'assurance de la qualité ?

Il s'agit d'un ensemble de recommandations et de directives qui, si elles sont suivies, assurera une meilleure qualité dans les domaines de la conception, de la construction et de l'entretien.

À qui ce protocole s'adresse-t-il ?

Aux concepteurs, aux fabricants, aux fournisseurs et aux poseurs dans le domaine de l'enveloppe du bâtiment (voir les définitions ci-dessous).

Dans le présent protocole, lorsqu'une recommandation ou une directive s'applique indifféremment à l'un ou l'autre de ces intervenants, on utilise le terme «fournisseur de l'enveloppe du bâtiment».

Lorsqu'une recommandation ou une directive se rapporte à un ou plusieurs intervenants en particulier, alors ceux-ci sont désignés par leur appellation traditionnelle.

Quel est l'objet de ce protocole ?

Ce protocole s'applique particulièrement au revêtement extérieur des collectifs d'habitation à ossature de bois, pour les besoins d'assurance de la qualité.

Toutefois, ce protocole peut s'appliquer, pour une bonne part, à n'importe quels travaux de construction.

Quand faut-il appliquer le protocole ?

Les exigences stipulées dans le présent protocole servent à compléter (et non pas à remplacer) les exigences énoncées dans les documents normatifs usuels en matière de conception et de construction.

L'adoption de ces exigences peut entraîner la modification de ces documents et des pratiques visées.

Lorsqu'il sera pertinent de le faire, le protocole renvoie l'utilisateur ayant besoin de directives additionnelles au *Guide des règles de l'art*.[1]

N. B. : Les exigences en matière de systèmes qualité stipulent les éléments de base que tout système qualité doit posséder, toutefois, le présent protocole ne vise pas à imposer l'uniformité des systèmes qualité.

Le présent protocole est un document générique. La complexité du système qualité mis en place dans une organisation dépendra de ses besoins, des produits et services qu'elle offre, et des procédés et pratiques qu'elle applique. Ainsi, un système qualité chez un fournisseur n'offrant qu'une seule ligne de matériau sera vraisemblablement plus simple que celui d'un entrepreneur général utilisant ce matériau et des douzaines d'autres.

Lorsque c'est faisable dans l'ensemble de la documentation sur le protocole, les points intéressant particulièrement certains membres des branches de la conception et de la construction sont mis en relief.

Le présent protocole stipule également les exigences en matière de système qualité à appliquer lorsque la capacité d'un fournisseur de l'enveloppement du bâtiment à concevoir

[1] À l'heure actuelle le *Guide des règles de l'art* n'a pas été publié dans sa version finale, de sorte que les renvois sont limités.

et à construire une enveloppe du bâtiment à ossature de bois doit être démontrée. Cette exigence est formulée parce qu'il a été établi que des enveloppes du bâtiment récemment construites présentaient des défauts réels. On prévoit que cette exigence deviendra une règle générale d'ici quelques années.
Les exigences stipulées en matière de système qualité visent principalement à mieux satisfaire le client en réduisant ou en faisant disparaître la non-conformité et la défaillance des enveloppes du bâtiment à toutes les étapes, de la conception jusqu'à l'occupation du logement et à l'entretien ultérieur.

Comment le protocole est-il appliqué?

Il existe de nombreuses méthodes possibles pour appliquer le protocole aux activités d'une personne ou d'une entreprise. La SCHL a chargé les auteurs du protocole de préparer du matériel de formation en vue d'un cours sur le protocole qui inclura des exemples pratiques d'application.

Chaque immeuble est unique et chaque fournisseur de l'enveloppe du bâtiment a un rôle unique à jouer. Si nous faisons une analogie entre le récit d'une histoire et la conception et la construction de chaque bâtiment, alors chaque fournisseur est un personnage qui prend part à l'histoire d'une manière unique, qui fait une contribution unique et qui aide à raconter l'ensemble de l'histoire. Le but de ce protocole est de s'assurer que l'histoire de chaque bâtiment finit bien. Comme un conte raconté aux enfants au moment de se mettre au lit, le protocole aidera les consommateurs, les clients, les occupants et les fournisseurs à dormir profondément, du sommeil de celui qui sait qu'il a conçu, qu'il a construit, qu'il occupe une habitation de meilleure qualité.

LES BASES DE LA *QUALITÉ PAR LA CONCEPTION*

L'Organisation internationale de normalisation (ISO) est une fédération internationale d'organismes nationaux de normalisation (les organismes membres de l'ISO). Le présent protocole d'assurance de la qualité a été préparé conformément à la norme internationale ISO 9001 (exigences de 1994), qui vise à assurer la qualité à l'intérieur des organisations intervenant dans les domaine de la conception ou de la production. Bien que d'autres normes ISO puissent s'appliquer aux entreprises faisant strictement de la fabrication, toute entreprise de conception ou de construction qui aura reçu une certification ISO l'aura fait en vertu de la norme ISO 9001.

Nous avons choisi la norme ISO pour les raisons suivantes.

1. Après avoir analysé d'autres formats, y compris les différentes approches de GQT (gestion de la qualité totale), nous avons établi que la norme ISO 9001 se rapporte à toutes les situations, ou presque, survenant dans les domaines de la conception et de la construction de l'enveloppe du bâtiment.

2. L'attribution de la certification ISO a commencé au Canada, et on prévoit que de nombreux gouvernements, administrations et institutions la rendront obligatoire au cours des prochaines années. Cette certification est déjà obligatoire dans beaucoup de pays. Les fournisseurs de l'enveloppe du bâtiment qui adopteront le présent protocole ne répondent peut-être pas encore à toutes les exigences requises pour l'obtention d'une certification ISO, mais comme le présent protocole s'inspire des lignes directrices énoncées par l'ISO et que rien dans son contenu ne

contredit la philosophie de l'ISO, la certification ISO sera plus facile à obtenir pour ceux qui auront adopté ce protocole.

Le diagramme suivant reproduit la structure des exigences contenues dans le protocole.

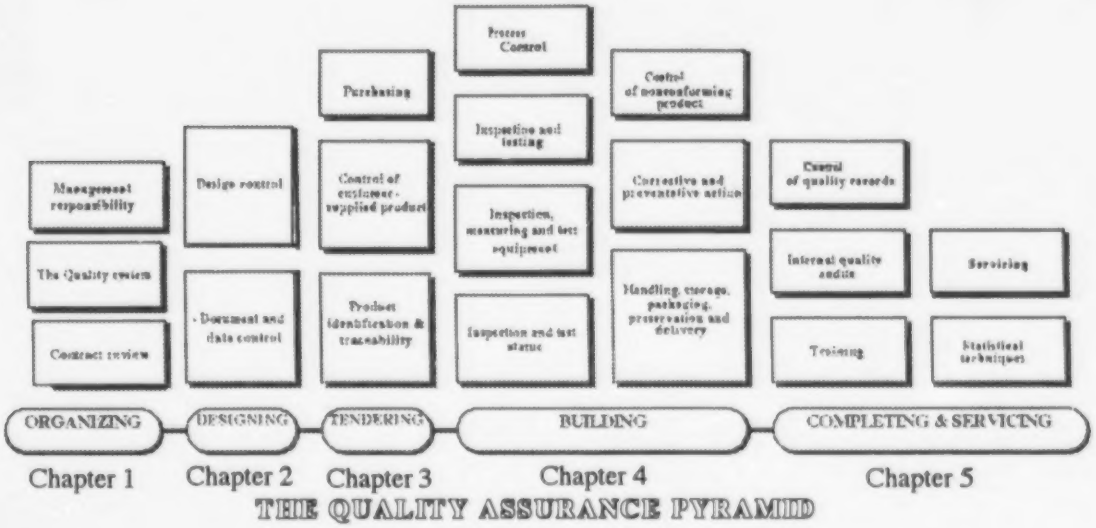

Figure 2.1 - La pyramide de l'assurance de la qualité - Structure organisationnelle pour le manuel sur la qualité

Afin de simplifier l'organisation du document et son utilisation, nous avons regroupé les 20 sections ISO, figurant dans les cases à coins angulaires ci-dessus, en cinq chapitres portant les titres reproduits dans les cases aux coins arrondis au bas de la pyramide.

INTRODUCTION TO THE QUALITY ASSURANCE PROTOCOL (QAP)

What is it?

- a set of recommendations and guidelines which, if followed, will assure an improved level of quality in design, construction and maintenance.

Who is it intended for?

- Building Envelope Designers, Builders, Suppliers and Installers in the Province of British Columbia (see definitions below).
- In this Protocol, where a recommendation or guideline applies to any of these parties, then that party is called a "Building Envelope Provider".
- Where a recommendation or guideline applies to one or more of these parties in their traditional roles, then the traditional names are used.

Where does it apply?

- Specifically, to the exterior of wood frame multi-residential buildings for quality assurance purposes.
- However, most of the protocol is usable on virtually any building project.

When should it be used?

- Requirements specified in this Protocol are complementary (not alternative) to the requirements specified in traditional design and construction documents;
- Their adoption may lead to modifications in those documents and associated practices.
- Where appropriate, this Protocol refers the user to the "Best Practices Guide" for specific guidance.[1]
- NOTE: Quality system requirements specify the base elements which any quality system should encompass, but it is not the purpose of this Protocol to enforce uniformity of quality systems.
- This Protocol is generic. The complexity of a quality system developed for any specific organization will be influenced by the needs of that organization, the products and services it supplies, and the processes and specific practices it employs. For example, a quality system for a material supplier with one product line may be somewhat simpler than that of the general contractor using that material and dozens of others.
- Where feasible throughout the Protocol documents, items of particular interest to some members of the design and construction team are so highlighted.
- This Protocol also specifies quality system requirements for use where a Building Envelope Provider's capability to design and/or construct a durable wood frame building envelope needs to be demonstrated. The requirement for demonstrating capability is emerging in reaction to real problems with recently constructed building envelopes, and it is anticipated this requirement will become general in the next few years.
- The specified quality system requirements are primarily aimed at achieving improved customer satisfaction by reducing or preventing non-conforming and non-performing building envelopes at all stages from design through to occupancy and maintenance.

How is it to be used?

- There are many approaches possible to applying this Protocol to the activities of a particular individual or company. CMHC has commissioned the authors of the Protocol to also prepare teaching materials for a course built around the Protocol, which will include practical examples of Protocol applications.

Each building is unique and each Building Envelope Provider has a unique role to play. If we were to think of each building's design and construction as telling a story, then each provider is a character who participates in

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1 At this time the *Best Practices Guide* has not been released in its final form, therefore cross references are limited at this time.

the story in a unique way, provides unique input and helps in telling the overall story. The purpose of this Protocol is to ensure each building story has a happy ending which, like a bedtime story, helps customers, clients, occupants and providers alike sleep easier and deeper in the knowledge that they have designed/ built/ inhabited a better building.

THE BASIS FOR *QUALITY BY DESIGN*

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). This Quality Assurance Protocol is prepared in keeping with International Standard ISO 9001: 1994 requirements, which are intended to assure quality in organizations involved in design and/or production. While other ISO standards may apply to companies strictly involved in manufacturing, any design or construction company which has achieved ISO registration will have done so under the umbrella of ISO 9001.

The ISO format was selected for these reasons:

1. After analyzing alternatives including various TQM (Total Quality Management) systems, it was determined that ISO 9001 best encompassed nearly all of the circumstances surrounding building envelope design and construction;

2. ISO certification has started in Canada and is expected to be mandated by many governments and institutions in the next few years. It is already mandatory in many countries. Building Envelope Providers who adopt this Protocol may not have met all of the appropriate ISO certification requirements, but this Protocol is organized along ISO lines and nothing in the Protocol is contrary to the ISO philosophy, therefore future ISO certification will be easier for those who adopt the Protocol.

The flow of quality assurance requirements inherent in this Protocol is illustrated by the following diagram(s):

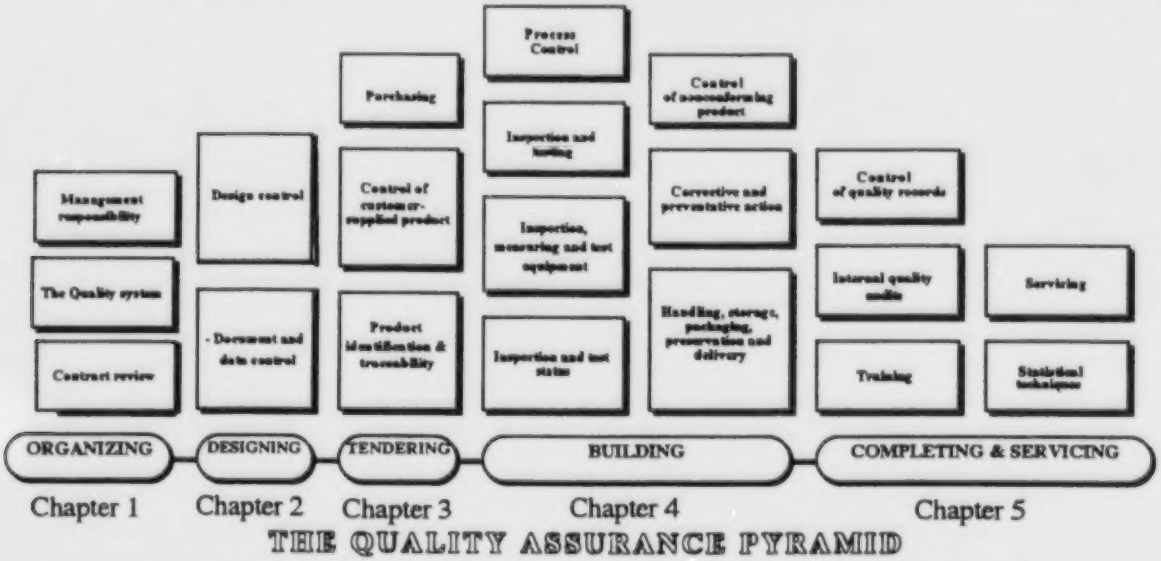

Figure 2.1 - The Quality Assurance Pyramid - an Organizing Structure for the Quality Manual

In order to simplify the organization of the document and its use, we have combined the twenty ISO sections in the square boxes above into 5 chapters carying the titles in the round-edged boxes at the bottom of the pyramid.

REFERENCES

Unless indicated otherwise, references in this Quality Manual are based on:

STANDARDS:

- ISO 9000 - 1 : 1994 "Quality Management and Quality Assurance Standards - Guidelines for Selection and Use"
- ISO 9001 : 1994 "Quality Systems: Model for Quality Assurance in Design, Development, Production, Installation and Servicing"
- ISO 9004 -1: 1994 "Quality Management and Quality System Elements - Part 1: Guidelines"
- ISO 8402 "Quality Vocabulary"
- ISO/TC 176/SC 2 SBTG N 18 "Quality Systems Explained - a Guide to the interpretation and Application of ISO 900 Standards for Small Business"
- Best Practices Guide CMHC/SCHL

LITERATURE:

TQM and ISO 9000 for Architects and Designers, McGraw-Hill, New York, 1996

"Total Quality Project Management for the Design Firm", Stasiowski, Frank A., John Willey & Sons, Inc., 1994

DEFINITIONS USED IN *QUALITY BY DESIGN*

(in alphabetical order, focused on Building Envelope content - novel definitions are in *italicized, bold type*)

Builder - **an organization or an individual performing construction services for a building project. May be a subcontractor, general contractor, design/build contractor.**

Building Envelope - **the horizontal, vertical and inclined assemblies which intercede between the interior and external environments.**

Building Envelope Provider - **any Designer, Builder, Supplier or Installer who is engaged in the provision of products and/or services which contribute to the construction of a building envelope.**

Building Envelope Reviewer - **an organization or an individual performing building envelope review activities for a building project, including, for example, design review and verification, construction in progress review and verification, submittal review and verification, and pre-occupancy completion/commissioning review and verification. May be an Architect, Engineer, Approved Building Envelope Specialist (in Vancouver), Building Envelope Provider, etc. Should be defined in each instance.**

Contract - **a documented agreement between two parties (Building Envelope Provider and customer or between two Building Envelope Providers) stipulating goods and/or services to be provided.**

Customer - **an organization or an individual for whom a Building Envelope Provider works. The Customer need not be the Owner of a project, nor the end user or Occupant of a project.**

Designer - **an organization or an individual performing design services for a building project. May include Architects, Landscape Architects, Engineers and Specialist Consultants such as Acoustical Consultants, as well as professionals preparing shop drawings or similar in-process design documentation.**

Developer - **an organization or an individual who assembles the land, resources, financing, design, construction and other expertise required to develop a building envelope.**

General Contractor - **an organization engaged in the construction of buildings by assembling the necessary material Suppliers and Installers and coordinating their construction efforts to produce a finished building.**

Installer - **an organization or an individual performing material installation services for a General Contractor or Builder.**

Manufacturer - **an organization or individual producing building envelope supplies from raw or semi-processed materials. Manufacturers supply suppliers - they do not provide product directly to a Project site.**

Mock-up - **a partial construction of the proposed building envelope, either in the building fabric or adjacent on the construction site, intended to illustrate interfaces between materials and products as well as construction sequencing.**

Occupant - **an organization or an individual occupying the completed building envelope.**

Owner - **an organization or an individual who holds title to a building envelope or a portion of the building envelope (i.e., a dwelling unit). Since an Owner may be absentee, it may be distinct from the Occupant.**

Product - **goods and services, or combination of goods and/or services, provided by a Contractor, Sub-contractor, Supplier and/or Installer.**

Project - **a design and construction project incorporating a building envelope component**

Quality Management Representative (QMR) - **for each Designer, Builder, Supplier and Installer, the individual designated as responsible for the quality of goods and services supplied to a Project.**

Site Superintendent - **the individual responsible for the construction activities occurring on a construction site.**

Sub-contractor - **an organization or an individual performing services for or delivering goods to a General Contractor or Builder.**

Submittal - **information and/or samples submitted during the course of construction, in support of proposed product design in detail, proposed materials, including warranties, proposed alternatives or substitutions, etc. Traditionally includes shop drawings, manufacturer's literature, samples, sample panels.**

Supplier - **an organization or an individual delivering goods to a Builder or General Contractor**

QUALITY SYSTEM REQUIREMENTS -

Introductory Comments

The Quality Manual which forms a part of the Quality Assurance Protocol which consists of 5 chapters incorporating the 20 Sections adapted from the ISO 9001:1994 standard. Earlier drafts of the Quality Manual had first 22, then 21, Then finally 20 Sections, however it became evident that all of the necessary content for the Quality Manual would be best summarized in 5 chapters.

For convenience and to provide an overview of the Quality Manual, these 5 chapters are summarized below. The summary should be reviewed by each individual or organization interested in quality assurance, because it highlights more succinctly the range of issues which must be addressed. Also, since the Quality Manual which expands these 5 chapters will be customized by each participating organization or individual, the summary provides a convenient starting point as well as a reminder of the generic quality principles which any Quality Manual should encompass.

Organization of Quality Manual Chapters

Each of the 5 chapters includes the content of the the appropriate sections of the 20 Section ISO format. Material is organized so that ISO conformance can be verified for those organizations choosing to apply for ISO certification.

Immediately below each section title is a box highlighting the content of that section of the chapter. It introduces key concepts and explains the importance of the section to quality assurance. The importance of a section to a particular Building Envelope Provider will depend upon the nature of its business.

After the introductory box follow the content headings which are derived from ISO, edited and modified as appropriate.

Explanatory or editorial comments designed to help in understanding specific content of the Quality Manual are shown like this paragraph.

Q-Tips - Suggestions, tricks, and experiences which may assist in the application of the Quality Assurance Protocol are inserted where appropriate in this Section in the form of *Q-Tips* - comments enclosed in boxes like this one.

Content of Sections parallels the appropriate ISO section, but has been edited and added to in order to identify more exactly with the design and construction of building envelopes. However, the content has not been edited so much that it eliminates the ability to apply the Protocol beyond the building envelope.

CHAPTER 1 ORGANIZING FOR QUALITY

1.1 Management responsibility

Introduction - Quality does not just happen. Every individual or organization interested in quality needs to organize for it. This section of the Quality Manual provides general guidance on establishing, maintaining and monitoring a quality policy.

Key concepts include:

- **The Quality Policy** ;and
- **The Quality Management Representative (QMR)**

Quality policy

Every company needs to define and document its own quality policy, which outlines its expected quality level and general approach to achieving that quality level. Each company needs to appoint a Quality Management Representative (QMR) to ensure that this policy is maintained at all levels in the organization.

Responsibility and authority for Quality

Each Building Envelope Provider appoints a company-wide QMR and, if the company scale merits, a QMR for each project or customer. In smaller companies, one QMR may deal with all projects/clients.

Resources for Quality

Restates the Building Envelope Provider's commitment to provide adequate resources for the performance of work and how it will verify its quality, including the concept of internal quality audits.

Quality Management Representative (QMR)

The concept of a Quality Management Representative (QMR) is not unique to this Protocol. What may be unique is the concept that the QMR should be identified on all contract and quality related documentation throughout the project.

The Quality Management Representative's responsibilities are outlined in this clause.

Management Review

States the Building Envelope Provider's management commitment to review the quality system at defined intervals, and a commitment to maintain records of such reviews.

1.2 The Quality system

Introduction - Achieving and maintaining quality requires a systematic approach. This section of the Quality Manual lays out the basics of establishing and maintaining a quality system.

Key concepts include:

- **The Quality Plan**, i.e., preparing it for each customer and verifying that it works.
- **The Quality Manual** which each company needs to implement *Quality by Design*.

General

The Building Envelope Provider establishes, documents and maintains a quality system as a means of ensuring that each Project conforms to specified requirements. The Building Envelope Provider prepares a Quality Manual covering the detailed requirements of this Protocol. The Quality Manual includes or makes reference to the quality system procedures.

Project Quality system procedures

The QMR's procedural framework is introduced here, especially how to deal with exceptions to quality.

The Quality Plan

The concept of a Quality Plan is introduced here and described in some detail.

We have developed a Quality Plan which spans the 5 chapters of the Quality Manual, yet may be broken into discrete segments. Refer to the Forms section of this Protocol. It is intended the forms will be available in electronic format as well as hard copy.

1.3 AGREEING ON QUALITY - Contract review

Introduction - Every contract, purchase order or other agreement can be an opportunity for quality development. This section of the Quality Manual provides general guidance on contract approaches which foster quality.

Key concepts include

- The **chain of quality** management representatives;
- incorporation of **quality requirements into all contracts**; and
- the **use of proposals and contracts to identify and resolve quality issues.**

The possibility of using these activities as **part of the marketing** of goods and services is introduced.

General

The concepts of Contract Review for quality assurance are introduced here. The concept of requiring identification of QMR's on contracts between a Building Envelope Provider and those above and below on the contract chain is suggested.

If each provider requires quality assurance for its suppliers and subcontractors, the quality chain should be continuous.

One key contract concept is the explicit review of tender/proposal documents to determine that specified items will meet stated quality objectives.

Where the contract is for services, this may be controversial as it may be seen to imply guarantees of quality.

This is an opportunity to market the goods and services as being more appropriate for the quality needs of the customer.

Definitions & Purpose

Traditional industry nomenclature is used to define the typical players to contracts. The basic purpose of contract review is discussed.

Responsibility

Control and assessment procedures are introduced here.

Procedure

Basic procedures (typical to well run businesses) are touched on here. Criteria for evaluating variations in quality or proposal are discussed.

Amendment

Whenever applicable, and in particular to resolve differences between contract requirements and best practices, an amendment to a contract shall be made and communicated within the Building Envelope Provider's organization. Channels for communication within the customer's organization should be established.

Although it may be controversial, changes to equality, especially reductions in quality, should be recorded, together with reasons.

Records

Records of contract reviews shall be maintained, including amendments and changes to quality..

Balancing Cost & Quality
What to do when discrepancies between Client quality criteria and likely outcomes of certain specified products occur is discussed here.

CHAPTER 2 DESIGNING FOR QUALITY

2.1 Design control

Introduction - Quality starts with the design process. This section of the Quality Manual provides general guidance on controlling designs as related to establishing and maintaining quality. It is appropriate not just for prime consultants, but for those who prepare shop drawings, "standard" manufacturers' details, etc.

Key concepts include:
- **Water management strategy** for dealing with water on and within the envelope;
- the **Best Practices Guide** relationship with design control.
- **the value of** Mock-up's.

Purpose of Design Control
Some of the publications and regulations which impact on building envelope design are noted.

Design planning
Factors to consider at each phase of design are listed here. A management plan for design and development activity is suggested, for updating as design evolves.
There are a variety of systems used for planning drawings. Refer to the recommended reading list attached to this Protocol. Key additions to any of these systems would be: a) identification of the Quality Management Representative; and b) correlation of designs to the Best Practices Guide and identification and rationalization of discrepancies between (if any). Refer to Section 4.4 of the Quality Manual for more discussion.

Organizational interfaces
The requirement for a Coordinating Registered Professional is tabled here, as are some of the job description elements for a QMR.

Design input
Design inputs are reviewed in some detail. Evaluation in relation to the 4 D's is suggested.
Deflection, Drainage, Drying and Durability

The concept of a building's "story" is introduced and explained.

4.a., the eventual programme of requirements should be "signed off" by the appropriate parties.

Design output
Design output is to be verified and validated against design input requirements.
What comes out reflects what goes in.

Design review
Documented reviews of the design are to be conducted.

A sample building envelope review meeting agenda, structured around the requirements of the building codes, is included in the Forms Section of this Protocol.

Records of such reviews are to be maintained.

Design verification - SIGN-OFF

Design verification is discussed as to staging (minimum repeats)

A generic building envelope design review checklist is included in the Forms Section of this Manual. This includes the traditional plan checking which some offices perform.

Design validation - MOCKUPS & SUBMITTALS

The differences between validations and verification are discussed.

Design validation is different than design verification. For example, verification might determine that a room's dimensions were correct and properly noted. Validation would confirm that the dimensions were appropriate to the proposed activities in it, that the room was properly placed, had the right character, etc.

Design changes

Design change procedures are introduced.

2.2 Document and data control

Introduction - Managing a project is a lot about managing the inevitable changes which occur at almost every phase. This section of the Quality Manual provides general guidance on establishing, maintaining and monitoring control of documents and data.

General

The Building Envelope Provider shall maintain control of all documents and data including, to the extent applicable, documents of external origin such as standards and customer drawings.

This suggests, among other things, the importance of maintaining applicable codes and standards on the construction site.

Document and data approval and issue

The Project documents and data shall be approved prior to issue. A master list identifying the current revision and issue status of documents shall be established and maintained.

The master list would ordinarily include contract documents, post tender addenda, alternative/ substitution/ change documentation, and submittals of all kinds.

In the case of Submittals, for example, one way of signifying approval is for the Designer to seal the design drawing. This is the method building authorities use to confirm approval by designers. It is also the only practicable method for designers to confirm approval of shop drawing designs by their designers.

Refer to the Forms Section of this Protocol for a generic document/submittal log form

This master list shall be designed to ensure that:

2.a. the pertinent issues of appropriate documents are identified and available;
b) the location and approval status of documents "in process" may be verified;
c) any obsolete documents are suitably identified for storage or destruction.

Document and data changes

Changes to documents shall be reviewed and approved unless specifically designated otherwise.

Thus, the generic drawing/submittals log should include a means of confirming that the quality aspects of the documents/data have been reviewed and approved, i.e., a check box.

CHAPTER 3 BUYING QUALITY

3.1 Purchasing

Introduction - Often, quality decisions are inadvertently or deliberately made at the purchasing phase. This section of the Quality Manual provides general guidance on establishing, maintaining and monitoring a purchasing policy which includes quality considerations.

General

The Building Envelope Provider for a given product or service shall ensure that purchased product or service conforms to specified quality requirements.

The submittal review form located in the Forms section of this Protocol should provide for quality requirements to be identified and verified.

Evaluation of subcontractors

The Building Envelope Providers shall:

a) evaluate and select sub-contractors, including applicable quality criteria;
b) define the control exercised by the Building Envelope Reviewer over subcontractors;

Providers should know what their submittal and review requirements include. This information should be included in specifications and other tender documents, by the tenderer if not by the designer.

c) establish and maintain quality records;

In the "chain of quality", each provider who "buys into" the quality approach of this Protocol will, as part of its Quality management system, have established quality records which should be easily verifiable by Customers. In cases where a Provider has not subscribed to the Protocol, the customer will have to spell out the records requirements or require the Provider to subscribe.

Purchasing data

Purchasing documents shall clearly describe the product ordered, including, where applicable:

a) the precise identification of the product;
b) the applicable issue of specifications, drawings and other pertaining documents

The Customer shall review and approve purchasing documents prior to release.

The customer can use the log suggested in 4.5 above for this purpose.

Verification of purchased product:

Verification at subcontractor's premises

Where it is anticipated to verify product at the Provider's premises, the method of product release shall be specified in the purchasing documents.

In construction, this refers to reviews at the providers' facilities, which are fairly unusual. In such an instance, it will be important to confirm that the conditions and details at the Provider's facility match those on site.

Customer verification of subcontracted product

Where specified in the contract, the customer shall be afforded the right to verify at the subcontractor's premises or upon delivery at the construction site or customer's other premises.

3.2 Control of customer- supplied product

Introduction - A carefully designed building envelope may be greatly affected by customer supplied items. This section of the Quality Manual provides general guidance on establishing, maintaining and monitoring a policy to control the incorporation of customer supplied product.

The Building Envelope Provider affected by customer supplied product provided for incorporation into the Project shall control that product . Any such product that is lost, damaged or is otherwise unsuitable for use shall be recorded and reported to the customer.

Generally, customer supplied product shall be subject to the same review and approval procedures governing other product.

3.3 Product identification and traceability

Introduction - It is often difficult to differentiate between a quality product and an inferior "knock off" or substitution. This section of the Quality Manual provides general guidance on establishing, maintaining and monitoring a product identification policy.

Whenever a particular product quality is specified, proof of that identification shall be maintained until reviewed and approved by the Building Envelope Reviewer.

This applies, for example, to product grades such as sheathing grades, to chemical product such as sealants , and to building code sensitive products such as firestop materials.

Where specified, product submittals shall identify incompatible interface products or environmental conditions.

For example, self adhering (peel & stick) membrane packaging or submittal information should indicate chemical or adhesive incompatibilities.. Materials such as brick should identify limitations on application temperature.

Whenever product traceability is specified, the Building Envelope Provider shall maintain the unique identification of individual products.

CHAPTER 4 BUILDING QUALITY

4.1 Process control = Building the Building

Introduction - Probably the greatest practical impacts on quality occur during the actual construction process. This section of the Quality Manual provides general guidance on establishing, maintaining and monitoring quality policies during construction.

Key concepts include the importance of **specifying quality and suitability** in terms **which can be measured.**

Controlled Conditions

The Building Envelope Provider shall ensure that construction processes are carried out under controlled conditions. Controlled conditions include the following:

a) documented procedures where the absence of such procedures could adversely affect quality;

For example, cold weather protection requirements for masonry or concrete or roofing, application temperature limitations for a wide variety of materials,, etc.

b) use of suitable equipment, and a suitable working environment;

For example, many products specify that they shall be applied to a dry substrate without defining what "dry" is. If the precondition for commencement of work cannot be specified clearly to a provider, workmanship criteria will not be practical.

For situations such as cutting holes in drywall for cable/ conduit penetrations, it is important to specify what equipment shall be used to perform such cutting and patching. This subject is usually covered in specifications but seldom enforced on site.

c) compliance with reference standards/codes and/or documented procedures;

This again underlines the value of keeping copies of relevant codes/standards on a site.

The Building envelope designer(s) should consider summarizing relevant standards rather than relying upon their being available on site, also to avoid conflicts where standards/codes change during the course of a Project.

d) the approval of processes and equipment, as appropriate;

Perhaps the Daily log of a Site Superintendent could include a summary of required processes/equipment, particularly those such as cold weather requirements which apply only infrequently.

e) criteria for workmanship, which shall be clear and practical;
f) suitable maintenance of equipment
g) design and construction of appropriate building envelope Mock-ups in advance of commencing work of affected trades
NOTE: To be effective, a Mock-up should include all of the materials of the building as well as typical and challenging interface conditions.

(NOTE: We have found the mock-up approach to be far superior to three dimensional graphics, etc., as a means of resolving envelope design issues.) Refer to Sections 4.9 and 4.10 for further information.

4.2 Review and testing

Introduction - In a perfect world, review and testing would not be required. In the meantime, such activities are important to verify the quality of proposed and installed materials and systems This section of the Quality Manual provides general guidance on establishing, maintaining and monitoring a review and testing policy.

General

At a minimum, the Site Superintendent or designate, the Building Envelope Provider and Building Envelope Reviewer shall all perform review and testing activities in order to verify that specified Project requirements are met.

Receiving review and testing

The Building Envelope Provider and Site Superintendent or designate shall ensure that incoming building envelope product is not used or processed until it has been inspected.

The amount and nature of receiving review shall reflect the amount of control exercised at the subcontractor's premises and as agreed with the Building Envelope Reviewer.

The Building Envelope Reviewer shall determine its extent of review and advise same through specifications or similar means.

In-process review and testing

The Building Envelope Provider shall

a) inspect and test the product;
b) hold product until the required review and tests have been completed or necessary reports have been received.

"Just in time" approaches do not work on construction sites.

The Building Envelope Reviewer shall

c) list for the Site Superintendent or designate products, materials and/or assemblies which are to be reviewed and/or tested;
d) be reasonably available to perform designated reviews/tests;
e) document and circulate results of those reviews/tests, including follow-up as regards deficiencies.

The Site Superintendent or designate shall

f) Provide the Building Envelope Reviewer with a time schedule indicating availability of designated products, materials and/or assemblies which are to be reviewed and/or tested;
g) review the subsequent time schedule for the designated products and advise of conflicts;
h) revise the time schedule as changes occur;
i) confirm in advance with the Building Envelope Reviewer that specific designated products, materials and/or assemblies which are to be reviewed and/or tested will be available at a specified time;
j) attend at the review/test;
k) follow up the results of those review/tests as appropriate.

Final review and testing

The Building Envelope Provider shall carry out all final review and testing to complete the evidence of conformance of the finished product or installation to the specified requirements, and submit said evidence to the Site Superintendent or designate, who shall forward same to the Building Envelope Reviewer. *This covers commissioning and in-process inspections which various Builders, Suppliers and Installers undertake before requesting a final review by the Building Envelope Reviewer. Designers may also perform pre-review activities, especially where they are acting as a Specialist Consultant such as a Sprinkler Design Engineer.*

The Building Envelope Reviewer shall determine the extent of its final review and conduct same after reviewing the Building Envelope Provider's evidence of final review and testing.

The final review and testing shall require that all interim review and tests have been carried out and that the results meet specified requirements.

Review and test records

The Building Envelope Provider shall maintain records which provide evidence that the product or installation has been inspected and/or tested. These records shall show clearly whether the product or installation has passed or failed the reviews and/or tests according to defined acceptance criteria. Where the product or installation fails to pass any review and/or test, the procedures for control of nonconforming product shall apply.

The Building Envelope Reviewer shall also maintain review records and provide copies of same, including where a product or installation has failed, to (at a minimum) the Quality Management Representatives of the Customer, the Site Superintendent, and relevant Designer(s).

In keeping with traditional lines of communication, the Site Superintendent should communicate these records as appropriate to Quality Management Representatives of Providers whose work is covered by a review and/or test.

4.3 Review, measuring and test equipment

Introduction - The measurement of quality sometimes requires instrumentation and equipment. This section of the Quality Manual provides general guidance on establishing, maintaining and monitoring an equipment policy.

General

The Building Envelope Provider or Reviewer, as appropriate, shall maintain control of the review, measuring and test equipment.

The technical data pertaining to the review, measuring and test shall be made available, when required by the customer, the customer's Quality Management Representative or the Building Envelope Reviewer.

Note that in this case the Reviewer may be, for example, a concrete testing company.

Control procedure

Where Design Control is affected, the Reviewer shall:

a) determine the review, measuring and test equipment that is necessary;

a) define the measuring and test equipment frequency of checks, and the action to be taken when results are unsatisfactory;

This requirement pertains, for example, to structural elements, mechanical balancing, spray testing of building envelope assemblies, etc.

The Building Envelope Provider and/or Reviewer shall:

a) determine the review, measuring and test equipment that is necessary;
b) calibrate review, measuring and test equipment at prescribed intervals, or prior to use, against certified equipment;
c) define the measuring and test equipment frequency of checks, and the action to be taken when results are unsatisfactory;
d) identify review, measuring and test equipment with a suitable indicator;
e) maintain calibration records.
f) ensure that the environmental conditions are suitable for the measurements and tests being carried out;
g) ensure that the handling, preservation and storage of review, measuring and test equipment is such that the accuracy and fitness for use are maintained;

4.4 Review and test status

Introduction - Materials and systems cannot be tested in a vacuum. This section of the Quality Manual provides general guidance on establishing policies for monitoring ongoing testing as to success, remediation, etc.

Identification & Record Keeping

The review and test status of the Project and its products and installations shall be identified by suitable means to ensure that only product which has passed the required reviews and tests is used or installed.

Refer to the Forms Section of this Protocol for a generic log of required reviews and tests. A successful typical method establishes a matrix of required tests and reviews for each level of a building, or for portions of each level where the building has a large floor plate or a phased floor plate construction requirement.

4.5 Control of nonconforming product

Introduction - In spite of all goodwill and efforts, some material and systems will fail their reviews/tests. This section of the Quality Manual provides general guidance on establishing, maintaining and monitoring a policy to deal with this eventuality.

General

The Building Envelope Provider shall ensure that product that does not conform to specified requirements is prevented from unintended use or installation.

Where advised of such non conformance, the Building Envelope Reviewer shall ensure that non conforming product is reviewed and disposed of as noted below.

Review and disposition of nonconforming product

The authority for the disposition of nonconforming product shall be defined. Where the authority has not been previously defined, it shall rest with the Building Envelope Reviewer unless otherwise agreed.

Nonconforming product shall be reviewed in accordance with documented procedures. As per those procedures, it may be

a) reworked to meet the specified requirements,
a) accepted with or without repair by concession,
b) regarded for alternative applications, or
c) rejected or scrapped.

Note: The proposed use or repair of product which does not conform to specified requirements shall be reported for concession to the customer.

Repaired and/or reworked product shall be reviewed and accepted by the Building Envelope Reviewer.

4.6 Corrective and preventative action

Introduction - Quality does not just happen. Every individual or organization interested in quality needs to organize for it. This section of the Quality Manual provides general guidance on establishing, maintaining and monitoring a quality policy.

General

Whenever required the Building Envelope Provider shall perform corrective and preventative action.

The Building Envelope Provider shall record any changes to the documented procedures resulting from corrective and preventative action.
The same problem will recur until the procedure(s) which caused it are changed.

Corrective action

The need for corrective action may be identified by any affected party, however it should be initiated, documented and confirmed through predetermined procedures endorsed within the contract.
Where a Designer, Building Envelope Reviewer or other affected party first encounters a situation needing correction, they may draft a CAR for consideration. Alternatively, the Designer, Building Envelope Reviewer or other affected party may note the need for corrective action in as review or test report, using ***highlighting*** *techniques of some kind.*

Corrective action shall generally be initiated by a Corrective Action Request (CAR) indicated by the Building Envelope Provider or Reviewer.
Rather than inventing a new form, it might be preferable simply to annotate site memo's, field review reports, etc., with CAR coding. This is the approach taken here.

Copies of documents including Corrective Action Requests shall be provided when first issued to (as a minimum)

a) Designer, Building Envelope Reviewer or other affected party and their Quality Management Representatives (QMR);

a) the QMR of the affected Building Envelope Providers.

Any corrective action shall encompass as a minimum the following scope:

b) responding to the customer, Designer or Building Envelope Reviewer concerns and complaints;
c) investigating the cause of identified nonconformities
d) determining the corrective action
e) confirming that corrective action has been taken and that it has been effective.

For simplicity and clarity, any form including possible CAR content should include sufficient space to document corrective action taken, preferably on a single sheet of 8-1/2 x 11 paper. Confirmation might be as simple as a check mark or initials in an appropriate location.

Preventative action

The preventative action shall include:

a) the use of appropriate sources of information such as quality records and customer complaints to detect, analyze and eliminate potential causes of nonconformities;

Refer to Section 4.14 of the Quality Manual for further discussion about methods of recording quality experience "on the job."

b) the steps needed to deal with any problems
c) action required to ensure that it is effective;

4.7 Handling, storage, packaging, preservation and delivery

Introduction - Quality products may easily be damaged before they are incorporated into the building envelope. This section of the Quality Manual provides general guidance on establishing, maintaining and monitoring an appropriate policy in this regards.

NOTE: Standard construction specifications usually treat the following subjects. Refer to Section 4.15 of the Quality Manual for some suggested wording.

General

The Building Envelope Provider shall ensure proper handling, storage, packaging, preservation and delivery of product.

Handling

The Building Envelope Provider shall provide methods and means of handling that prevent damage or deterioration.

Storage

The Building Envelope Provider shall use designated storage areas or stock rooms to prevent damage or deterioration of product. Appropriate methods for authorizing receipt to and the dispatch from such areas shall be stipulated.

The condition of product in stock shall be assessed at appropriate intervals.

Packaging

The control packing, packaging and marking processes shall ensure conformance to specified requirements.

Where the Building Envelope Provider and/or Reviewer is to review/accept product, the packing, packaging and/or marking shall be retained until reviewed and/or accepted.

Preservation

The Building Envelope Provider shall apply appropriate methods for preservation and segregation of product.

Delivery

The Building Envelope Provider shall protect the quality of product after final review and test.

CHAPTER 5 COMPLETING & SERVICING

5.1 Control of quality records

Introduction - Records serve at least two purposes. Where properly evaluated, they provide lessons to improved quality. Where failure or problems occur, they document relevant activities and may serve to exonerate. This section of the Quality Manual provides general guidance on establishing, maintaining and monitoring a quality records policy.

The Building Envelope Provider shall maintain quality records.

Quality Records

These include but are not limited to:

a) internal quality and quality audit records;
b) the Quality Plan for a project;
c) Contractual agreements relating to quality;
d) Design quality records, including records of deliberate deviations from Best Practices;
e) Document/data records such as status logs;
f) Product quality verification records;
g) Corrective and preventative action records.

Quality records shall be maintained to demonstrate achievement of the required quality.

NOTE: Refer to Section 4.2 of the Quality Manual for a discussion of appropriate ways to organize a Quality Plan and Quality Records, using the 10 typical phases of a project

Quality records shall be legible and shall be stored in a suitable environment to prevent damage and loss. Quality records shall be made available for evaluation by the customer.

5.2 Internal quality audits

Introduction - Quality should be measured internally as well as externally This section of the Quality Manual provides general guidance on establishing, maintaining and monitoring an internal quality audit policy.

The Building Envelope Provider shall maintain internal quality audits to verify the effectiveness of the quality system.

Internal quality audits shall be scheduled on the basis of the status and importance of the activity to be audited.

The results of the audits shall be recorded. The personnel responsible for the area shall take timely corrective action on the deficiencies found during the audit.

5.3 Training

Introduction - Quality can and must be taught - to Designers, Builders, Suppliers and Installers alike. This section of the Quality Manual provides general guidance on establishing, maintaining and monitoring a quality teaching policy.

The Building Envelope Provider shall identify its training needs and provide for the training of personnel.

Personnel performing specific assigned tasks shall be qualified on the basis of training and/or experience.

Records of training shall be maintained.

5.4 Servicing

Introduction - Quality does not equate to invincibility or zero maintenance. This section of the Quality Manual provides general guidance on establishing, maintaining and monitoring a building envelope maintenance policy.

The Building Envelope Provider shall provide at the submittal stage information disclosing the maintenance requirements for proposed product.

It is recommended that a building envelope maintenance manual be prepared for each completed building and conveyed to its owner(s).

After submittal review and approval, the Building Envelope Provider shall supply and/or install the product consistent with the accepted maintenance requirements. Conditions which may compromise accepted servicing or reduce accepted servicing intervals shall be specifically identified to the Building Envelope Reviewer, who will make recommendations which may include:

a) acceptance of compromised or reduced servicing, with reasons recorded;
b) rejection of the subject conditions, with proposed remedial or alternative recommendations;
c) recommendations for alternative or substituted product or detailing;
d) another approach consistent with Section 4.14 (Corrective and Preventative Action)

Where post completion servicing is a specified requirement, the Building Envelope Provider shall maintain quality records verifying and reporting that the servicing meets the specified requirements.

5.5 Statistical techniques

Introduction - Quality is measurable This section of the Quality Manual provides general guidance on establishing, maintaining and monitoring a statistical techniques policy. Note that this is anticipated to be a relative compact portion of the Quality Manual

Identification of need

The Building Envelope Provider shall identify statistical techniques required for verifying product characteristics.

This would include, for example, the quantity and disposition of appropriate testing or sampling of building envelope characteristics. The City of Vancouver now requires Approved Building Envelope Specialists to test wood structure and sheathing for moisture content, but does not specify where or how much. This section of the Quality Manual would address that requirement and others, relying on the Best Practices Guide for scientific assistance.

Procedures

The Building Envelope Provider shall establish and maintain documented procedures to implement and control the application of the statistical techniques.

Pursuing the example of sheathing moisture content measurements noted above, this Section, relying on the Best Practices Guide, will recommend how to measure moisture content.

APPENDIX A - Forms for Quality Management

Introduction - Whether virtual (i.e., on computer) or traditional (i.e., on paper), quality management must rely on forms and formats for its success. The attached forms try to achieve a balance between being generic enough so as to be easily adaptable and all inclusive while being specific enough to be practically useful. Each form is provided in electronic form as well as hard copy, and user feedback and suggestions for improvements are welcomed.

CANADA MORTGAGE AND HOUSING CORPORATION

Quality by Design

a Quality Assurance Protocol for Wood Frame Building Envelopes in British Columbia

January 25, 1999

BERC

CMHC SCHL
Canada

CMHC SCHL

QUALITY MANUAL

forming part of the Quality Assurance Protocol for Wood Frame Building Envelopes in the Province of British Columbia

to suit ISO 9001: 1994
Final Draft - October 1, 1998

Controlled Document	YES	NO
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INDEMNITY

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1.3 INTRODUCTION

1.3.1 NOTES TO THE READER OF THIS DRAFT

1. This document outlines the typical Quality Manual content which an organization or individual subscribing to the Quality Assurance Protocol would use. It is anticipated each subscriber would edit their Quality Manual to incorporate their particular activities and approaches, as well as their own experience

2. The entire document has been set up as an outline document, meaning that text is hierarchically arranged. Deletion of a heading deletes all material which relates to that heading. The documents can be "collapsed" so that only major or major/minor headings are visible, allowing quick movement through the document for editing purposes. This advantage will become more apparent to those who purchase the electronic format of the Protocol.

3. The cross referencing of this Manual to the Best Practice Guide has barely started, since the latter document is not complete for our use.

4. In this draft document, [square bracketed text] like this signifies text yet to be inserted.

5. This document is a key part of the Quality Assurance Protocol, which also includes a separate Introductory document.

1.3.2 FOREWORD

The Quality Assurance Protocol, of which this Quality Manual forms a part, was commissioned by Canada Mortgage and Housing Corporation in order to establish a management system for the assurance of quality of the exterior of multi-storey wood frame buildings located in the coastal climate of British Columbia. This is part of the initiatives undertaken by the Building Envelope Research Consortium, of which CMHC is a prominent member, to address the "leaky condo" issue as it pertains to new construction

We believe the Quality Assurance Protocol is important for these reasons:

- It brings together the building envelope quality thinking of a representative sample of all of the design and construction professionals who design and construct building envelopes;
- It is designed to be practical and usable;
- It is designed as a basis to be built upon by designers, builders, suppliers and installers of the building envelope. It is not exclusive nor does it exclude anyone involved in building envelopes from "buying in";

- It is based on a recognized international standard, ISO 9001:1994, which is a quality system standard likely to become prevalent in Canada in the next few years. Persons adopting the Protocol will find it eases their future adoption of ISO 9001 or similar standard quality systems;

Although this Manual is focused on the exterior of multi-storey wood frame buildings, i.e., their "building envelope", it has been designed such that its use could be expanded to other building forms as well as to other aspects of design and construction practice. The Quality Manual portion of this Protocol is expected to be available on disc to purchasers, allowing them to customize it to their needs

A major challenge in developing the Quality Assurance Protocol was simply to define what it is and consists of. The first paragraph above provides as good a definition as any. As a minimum, the Protocol includes the following documents:

1. An Introductory document;
2. This Quality Manual;
3. The Best Practices Guide;
4. Associated Forms, some of which are included as an Appendix to this Manual

Items 1 and 2 are specific products of our contract with CMHC. Item 3 is being developed concurrently by others and reviewed by us for integration with the Quality Manual. Item 4 has been introduced with the Quality Manual, however each adopter of the Quality Assurance Protocol will probably add to its content in association with the particulars of their building envelope involvement.

1.3.3 PURPOSE

This Quality Manual outlines the procedures which an adopting organization uses to promote quality in its role as a Building Envelope Provider. It is based on International Standards Organization Standard ISO:9001-1994, an internationally recognized objective measurement of quality service and products.

Building Envelope Providers who adopt this Manual as their guide to quality assurance will find that certain elements of the Manual do not apply in whole or in part to their organization. Obviously, a generic document aimed at Designers, Builders, Suppliers and Installers will include more than most individual Providers need. It is expected individual Providers will edit the Manual content as appropriate for their organization.

The value of this Manual as constituted is that it does provide for virtually all quality related activities for any Provider. Providers who adopt this Manual will find, when they apply for ISO certification, that their operations are already consistent with ISO requirements. In other words, future certification will be much easier. In the meantime, they will enjoy the benefits of improved quality.

1.3.4 REVIEW & REVISIONS

This Draft is circulated for comment and critique. It is hoped all readers will contact the writers with suggestions. **Please contact:**

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1.3.5 CONTROL & RECORDS

It is recommended that users of this Quality Manual keep the "auto-date" function exhibited in the header on this and other Manual pages. In this way, every time a section is revised and reissued, the issue date is automatically incorporated with the printing.

It is also recommended that Manual users make a record (hard copy or electronic) of the Manual before they initiate any revisions based upon their own organization. It is important that revisions be seen to be logical rather than serendipitous.

As per the Content of this Manual, subscribers should keep a record of their own revisions to this Manual.

1.5 DEFINITIONS/ VOCABULARY

Builder - an organization or an individual performing construction services for a building project. May be a subcontractor, general contractor, design/build contractor.

Building Envelope - the horizontal, vertical and inclined assemblies which intercede between the interior and external environments.

Building Envelope Provider - any Designer, Builder, Supplier or Installer who is engaged in the provision of products and/or services which contribute to the construction of a building envelope.

Building Envelope Reviewer - an organization or an individual performing building envelope review activities for a building project, including, for example, design review and verification, construction in progress review and verification, submittal review and verification, and pre-occupancy completion/commissioning review and verification. May be an Architect, Engineer, Approved Building Envelope Specialist (in Vancouver), Building Envelope Provider, etc. Should be defined in each instance.

Contract - a documented agreement between two parties (Building Envelope Provider and customer or between two Building Envelope Providers) stipulating goods and/or services to be provided.

Customer - an organization or an individual for whom a Building Envelope Provider works. The Customer need not be the Owner of a project, nor the end user or Occupant of a project.

Designer - an organization or an individual performing design services for a building project. May include Architects, Landscape Architects, Engineers and Specialist Consultants such as Acoustical Consultants, as well as professionals preparing shop drawings or similar in-process design documentation.

Developer - an organization or an individual who assembles the land, resources, financing, design, construction and other expertise required to develop a building envelope.

General Contractor - an organization engaged in the construction of buildings by assembling the necessary material Suppliers and Installers and coordinating their construction efforts to produce a finished building.

Installer - an organization or an individual performing material installation services for a General Contractor or Builder.

Manufacturer - an organization or individual producing building envelope supplies from raw or semi-processed materials. Manufacturers supply suppliers - they do not provide product directly to a Project site.

Mock-up - a partial construction of the proposed building envelope, either in the building fabric or adjacent on the construction site, intended to illustrate interfaces between materials and products as well as construction sequencing.

Occupant - an organization or an individual occupying the completed building envelope.

Owner - an organization or an individual who holds title to a building envelope or a portion of the building envelope (i.e., a dwelling unit). Since an Owner may be absentee, it may be distinct from the Occupant.

Product - goods and services, or combination of goods and/or services, provided by a Contractor, Sub-contractor, Supplier and/or Installer.

Project - a design and construction project incorporating a building envelope component

Quality Management Representative (QMR) - for each Designer, Builder, Supplier and Installer, the individual designated as responsible for the quality of goods and services supplied to a Project.

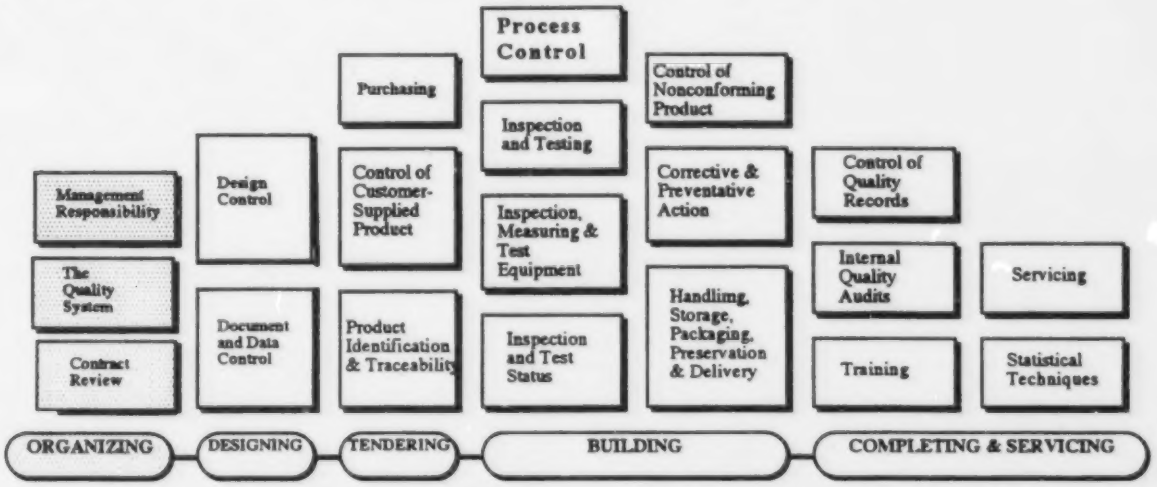
Site Superintendent - the individual responsible for the construction activities occurring on a construction site.

Sub-contractor - an organization or an individual performing services for or delivering goods to a General Contractor or Builder.

Submittal - information and/or samples submitted during the course of construction, in support of proposed product design in detail, proposed materials, including warranties, proposed alternatives or substitutions, etc. Traditionally includes shop drawings, manufacturer's literature, samples, sample panels.

Supplier - an organization or an individual delivering goods to a Builder or General Contractor

Chapter 1 ORGANIZING FOR QUALITY



THE QUALITY ASSURANCE PYRAMID

Introduction - Quality does not just happen. Even after an organization's management and staff are committed to quality, they need the means to implement it - a Quality *System* This chapter provides general guidance on establishing, maintaining and monitoring such a Quality System.

What is ORGANIZING FOR QUALITY ?

- Establishing specific communication strategies to motivate people to listen, think, and interact about quality issues;
- Establishing milestones in the Quality assurance process which require participants to meet face to face;
- Creating a peer pressure structure which fosters performance to a higher level of quality;

Key Concepts -

- **The Quality Plan** - An overall framework for developing and maintaining quality in an organization and on a particular project.
- **The Project Quality Plan -** The framework for developing and maintaining quality in an organization and on a particular project.
- **The Quality Management Representative (QMR)** - The individual in any organization responsible for the organization's quality performance. The QMR may be different people for different customers or projects.

- **Four Contract Review Criteria** to be considered in Contract Review in a Quality conscious environment:
- 1. Ensuring that contractual requirements are adequately defined and documented and reflect customer expectations, product application, etc.;
- 2. Identifying and resolving how differences between contract or tender requirements and product/process specifications;
- 3. Ensuring capability to meet contractual requirements. (This requirement probes the Contractor's ability to complete defined stages of the building envelope within an agreed schedule.)
- 4. Documenting that the above were considered and addressed.

Value of this Chapter - This introductory chapter to the Quality Manual is based on the International Standards Organization ISO 9001:1994 Quality Standard. Yet, the framework for quality assurance can be simplified and focused for design and construction activities.

For the conscientious Contractor, properly performed Contract Review represents an opportunity to recognize the full implications of costs, quality, construction and warranty to the overall customer's project timing. This approach is well justified as problems that have been experienced with poor quality building envelopes have often been due to the lack of an organized approach to setting out and evaluating construction schedules, realistic cost limits, the Contractor's capacity and capability, and subsequent attempts to adhere to these parameters.

Q-Tips - are suggestions, tricks, and experiences which may assist in the application of the Quality Assurance Protocol are inserted where appropriate in this Chapter in the form of *Q-Tips* - comments enclosed in boxes like this one.

1.1 Management Responsibility

1.1.1 Quality policy

The Building Envelope Provider's management defines and documents its policy for achieving quality results in accordance with the format which follows. The organization's **Quality Management Representative (QMR)** ensures that this policy is maintained at all levels in the organization.

The format is important as it follows the ISO 9001 format. If the format is reasonable maintained, future ISO certification becomes much easier.

Q-Tip - **Who are the QMR's ? -** Depending on the organization's size and scope, it would be useful to identify QMR's on business cards and project documentation. If nothing else, adding the designation "QMR" or "Quality Management Representative" will spark some inquiries from clients and colleagues - it has in our case.

1.1.2 The Quality Management Representative (QMR)

The concept of a Quality Management Representative (QMR) is not unique to this Protocol. What may be unique is the concept that the QMR should be identified on all contract and quality related documentation throughout the project.

The more senior the QMR is, the more readily will the quality management message generally be absorbed by staff. In a small organization, say up to 10 staff, it is best if the QMR is the President, Vice President Quality Assurance or a similar level senior operating officer.

The Building Envelope Provider appoints a Quality Management Representative with responsibility for quality and, in particular for:

a) ensuring that a quality system is established and maintained;
b) reporting on the performance of the Quality System to senior management;
c) monitoring the performance of the quality system on each contract

Refer to the Forms section of the Manual for a generic Quality Monitoring Form [to come]

d) acting as the contact for Customers in regards to quality issues

This requires that the QMR be named on contracts and related quality documents.

Q-Tip - **A QMR "Cheat Sheet"** - In the same way that companies often have a "cheat sheet" of in-house contacts for aspects of a project or certain types of information about a project or product, it would be proactive to have a "cheat sheet" of QMR's for each project or product. Then, whenever any inquiry is made, there will always be a contact who can be referred to as "our Quality Manager for that project/product..."

The QMR is identified on each contract, together with appropriate wording indicating the nature of the quality function in the organization.

If the QMR changes, initial duties of the new QMR shall include:

a) informing each Customer of the change and any changes to contact information;
b) reviewing the status of each existing contract

These directions may seem obvious but are essential.

1.1.3 Organization

1.1.3.1 Responsibility and authority for Quality - OVERALL

Who has overall responsibility for Quality?

Define and document the responsibility, authority and the interrelation of personnel who manage, perform and verify work affecting quality on an overall basis and for each Project and/or Customer.

This might be a simple organizational chart or a complex matrix, depending upon the organization. Just developing this kind of chart can often reveal flaws or gaps in the quality assurance approach.

On a company wide basis, this responsibility and authority information is located:

_____

(Name of QMR with overall responsibility)

_____

(Location of QMR/ Tel/Fax/ E-mail)

The Quality Manual needs to track its own management.

1.1.3.2 **Responsibility and authority for Quality - PROJECT(S)**

Who has responsibility for the Quality of each project?

Define and document the responsibility, authority and the interrelation of personnel who manage, perform and verify work affecting quality on a particular project.

On a Project and/or Customer basis, this responsibility and authority information is located:

_____

(Project / Customer Name)

_____

(Name of QMR responsible)

_____

(Location of QMR/ Tel/Fax/ E-mail)

The assumption here is that there is a Quality Manual dedicated to each project.

1.1.4 Management Review

The Building Envelope Provider's management shall review the quality system at defined intervals. Records of such reviews shall be maintained.

Quality system review records are located at:

_____

(Insert location)

Again, management must track its own quality assurance systems.

For this company/project (delete one), the review schedule is as follows: (List dates and sign-off's):

(Date) _____

(Reviewed by)_____

(Date) _____

(Reviewed by)_____

(Date) _____

(Reviewed by)_____

1.2 The Quality System

1.2.1 General

Establish, document and maintain a quality system as a means of ensuring that each Project conforms to specified requirements.

Prepare a **Quality Manual** covering the detailed requirements of this Protocol. Include or make reference to the quality system procedures in the Quality Manual.

A bit of catch 22 here, but necessary to refer to the Manual of which this Chapter is a part.

Q-Tip - **Quality Manual Preparation** - Think about the format for a Quality Manual relative to the business. Consider:

- A business which is primarily an Installer may benefit from a Manual which installers can carry and easily refer to;
- A supplier's Manual might be built around the size/design of its paperwork;
- A designer's Manual should match the physical format of its documents;

Q-Tip - **Project Filing for <u>any</u> Project** - Some years ago we evaluated a number of approaches to filing documentation for our projects, which include traditional architecture, building science, specialized building code analysis, design counseling and lately, earthquake upgrading. We arrived at 10 Phases or Stages which, so far, encompass every project we have worked on, ranging from residential renovations to major planning projects. Our phases (which are neatly contained in bulk-ordered 1-10 numbered binder tabs) are:

1 Administration/ set-up/ contracts
2 Planning & planning permission/ scheduling
3 Design/ design development
4 Building Permitting
5 Tendering/ Award of Contracts
6 Construction Phase
7 Changes to the Work
8 Submittals
9 Field Review
10 Completion/ Occupancy/ post occupancy

Use them as you wish!

1.2.2 Project Quality System Procedures

Name a **Project Quality Management Representative (QMR)** as noted above for each Project and/or Customer, and identify that QMR to all parties within and without the organization who have involvement with the Project.

The importance of identifying the QMR for each project cannot be overstated.

Whenever a Project QMR discovers an aspect of the Quality Plan which does not appear to work for a specific Project, or develops new Plan content, refer this information to the company-wide QMR who will:

a) Confirm the exception is appropriate for the Project;

b) Determine if the exception should be part of the company-wide Plan or some or all Project Plans, and communicate that finding to affected QMR's and company staff affected by the exception.

(Some variations are "one-of's", others are part of ongoing learning).

Amend the company wide or Project specific Quality plan to identify changes, and communicate those changes to affected staff, colleagues, etc.

Q-Tip - **Communicating Change** - Look at the format of a typical press release for ideas about communicating Quality Plan changes. There is no reason why quality improvements should be hid under a bushel.

1.2.3 The Company Quality Plan

Design and construction are complex activities involving a wide range of sizes and types of organization. Yet, the basic requirements for a Quality System are simple and common to all: a Quality Plan defining the organization's approach to quality assurance; a Project Quality Plan refining the general approach on a project by project basis; and a Quality Management Representative responsible for the organization's general and project by project approaches.

Develop and maintain an organization-wide **Quality Plan** which:

a) Outlines the responsibilities of the organization needed to meet quality goals, in a format consistent with this Manual;

All readers and users of the Quality Manual need a clear understanding of the quality program.

For an organization-wide Quality Plan, this focus on project oriented process responsibilities rather than job descriptions will help clarify roles, especially to outsiders who are not familiar with or interested in an organization's internal structures.

b) Provide for an indication of dates when responsibilities are required to be completed, as well as a means of indicating they have been attended to;

This may be a one-time schedule for initial set-up of quality systems, or components of a project schedule, or both.

c) Indicate who, both within and without the organization, is responsible for an item or may affect its success;

QMR's in the client and supplier firms dealt with should be identified.

Q-Tips - **Quality Contacts** - Most construction shacks have a bulletin board full of business cards and scrawled phone numbers with contacts for all manner of product and service. On a company wide basis or a project by project basis, it would be useful to neaten up that contact list and restrict it to those who have bought into the Quality Assurance Protocol. Initially, this might be an 'A' list and a 'B' list. If the 'A' list were identified as quality companies, preferred suppliers, etc., there would arise pressure to join that 'A' list. If the 'A' list is being developed and maintained by the project/company QMR, there will be a gradual winnowing out of poor quality Providers.

A surprising number of otherwise well managed construction companies have different Provider lists for each project - the reason seems to be the personal experience and preferences of the individual site superintendents.

d) Includes sufficient explanatory material in its body so that it is easy to use;

Because the Quality Plan refers back to specific clauses throughout the Quality Manual, and is customizable (it is a Word 5.1a for Mac table documents, easily imported into DOS Word, WordPerfect, etc.), it can become a stand alone plan for each Project, with perhaps a master being updated to reflect company wide experience.

e) aims to get quality information quickly into the hands of those who must implement it;

Q-Tips - **Informal Notation** - There is no reason Q-Tips and similar forms of notation injected into design drawings, packaging, assembly instructions, etc., cannot become standard practice. Informal notations already occur all over packaging, buildings under construction, etc., but they are usually not captured for reuse on future work.

f) Ensures that Customers are made aware of the consequences of disregarding information which may adversely affect the quality of the completed Project.

There needs to be a formal communication of consequences in each instance where a Customer appears willing to ignore advice. This is always a tricky communication, but essential.

A sample of the Quality Plan for this Chapter of the Quality Manual is included at the end of this Chapter with explanatory material. Each subsequent Chapter of the Quality Manual has a similar Quality Plan in its body, and there is an overall Quality Plan included in the Forms Appendix appended to this Quality Manual, which is suitable for use on an organization wide or project basis.

1.2.4 The Project Quality Plan

Any Contractor can usually contribute significantly to building envelope quality and costs by taking a pro-active approach to the customer's needs. This often involves recognizing previous experience and past challenges as opportunities for improvement, rather than simply reacting to problems when they are already experienced, which may result in customer dissatisfaction and warranty implications.

Develop and maintain a **Project Quality Plan** for each project which:

a) Communicates the Owner's quality intentions for the project.

For example, is the project for Owner occupancy, lease/rent, sale, etc. Is the intended maintenance regime minimal (self-maintained), periodic (property management company on call), regular (property management on premise) or continuous (resident caretaker). Contradictions between occupancy and maintenance may thus be discovered to exist (e.g., periodic maintenance for a Project with continuous, heavy use).

Q-Tips - **A Quality Plan at the Proposal Stage** - In our building science practice, our proposals relating to new construction include a few questions about the expected life of the building, the proposed form of tenure, the approach to maintenance, etc. We ask Clients to "fill in the blanks" right at the proposal stage, so that our contract includes key quality expectations from the beginning.

b) Identifies and resolves identified conflicts between quality intentions.

Referring to the Q-tip immediately above, we may have to explain to a Client that durability expectations are inconsistent with the intended maintenance program.

c) Outlines the responsibilities of the organization needed to meet quality goals for a specific Project or Customer, in a format consistent with this Manual;

In most instances this will be a repeat of the company's current version of its overall quality goals. Any instance where the overall goals are changed for a project is a signal that the Project merits careful review.

d) Provides for an indication of dates when responsibilities are required to be completed, as well as a means of indicating they have been attended to;

A schedule by any other name! See the sample Project Quality Plan format appended to each Chapter.

e) Indicates who, both within and without the organization, is responsible for an item or may affect its success

f) Includes sufficient explanatory material in its body so that it is easy to use

There is always a need for continuing education, but all of the "curriculum" needs to be in one place.

g) Summarizes quality acceptance criteria for each element of the Plan;

i.e., when is it good enough?

h) Constitutes an appropriate record or log of quality assurance activities for a project.

It's essential the Manual not be a hard bound seldom used reference book. Flexible formats such as a loose-leaf binder are preferred.

i) Identifies the Coordinating Registered Professional (CRP) responsible in law for the coordination of Project Designers.

This is both a legal requirement and common sense. It's often not clear where "the buck stops" as regards quality decisions.

Depending on the Project, it would be useful to reproduce the sections of the various contracts (Client/Architect, Contractor/Owner) which affect quality control throughout the design and construction phases - could be a substantial appendix!

j) Includes a matrix of who is included in what communications.

Our policy is to include everyone who might possible be affected - fax and e-mail is cheap, especially compared to litigation.

1.3 Contract Review

This section of Chapter 1 details procedures to be applied to "requests for proposals, tender or quotation" in a manner designed to foster quality in building envelope design and construction. It recognizes that Products and Services may be delivered within a variety of project delivery formats, including:

- *Contractor as General Contractor*
- *Contractor as Design/Build Contractor*
- *Contractor as Construction Manager*
- *Contractor as Project Manager*
- *Contractor as Owner*

It is beyond the scope of the Quality Manual to differentiate quality based upon Project Delivery approach. In fact, the approach is seldom known from the outset and often changes, so it becomes important to develop Contract Review procedures which are appropriate to any of these delivery models.

1.3.1 Contract Review: Definitions and Purpose

Contract Review follows documented and maintained procedures in order to:

a) document customer needs and/or requirements;

What do they want?

b) resolve identified discrepancies, if any;

How does that work?

c) ensure that adequate capacity and resources are available to meet on time customer requirements

How on earth do they expect us to do it in that time frame?

1.3.1.1 Definitions

NOTE: Throughout this chapter of the Manual:

"Bid" means a proposal, tender, quotation or bid for the provision of services, products and/or installations for a Project, including professional services.

"Bidder" means an individual or organization in the process of proposing to a Customer a fee for services, products and/or installations

"Bid Documents" means all drawings, specifications, programmes, schedules, addenda, etc., provided to a Bidder as support to the preparation of a Bid.

"Building Envelope Quality /Cost Criteria" means information in Bid Documents which states the Owner's expectations as regards the balance of project costs with expected durability and maintenance requirements.

1.3.2 Contract Review - Responsibility

The Bidder's personnel (generally those with responsibility for Sales) maintain control over and ensure compliance with all relevant procedures related to Contract Review activities.

Assess and confirm the following before submitting any Bid:

a) general ability to provide required services

b) availability of the required resources including equipment and skilled personnel with required expertise and experience

c) available capacity and capability

Realistically, the construction industry has been terrible at all three of these. "Low bid" mentalities and an uncertain marketplace for goods and services cause otherwise reasonable people to kid themselves about these aspects of a bid. A truly effective Quality Plan will allow for these vagaries both in the way the company is operated and its approach to each project.

Review Bid Documents, participate in Bid Preparation and review the final Bid prior to its submission, in order to confirm the Bid provides for a level of quality consistent with the Bidder's Quality Plan and the Owner's quality expectations.

As noted above, try to discern the Owner's/ Client's expectations from the beginning and be explicit about that understanding.

1.3.3 Contract Review - Procedure

Complete Contract Review activities at the Request for Quotation stage (or Invitation for Tender stage) and before acceptance of a contract, and document on a Contract, Purchase Order or Work Order, as appropriate.

Ensure contract agreements include:

b) Quality/Cost Criteria;

c) Durability expectations;

d) Maintenance expectations

Combine related activities in contracts and agreements, to reduce the total number of contracts, the dispersion of responsibility and the incidence of coordination problems.

Increasingly, Contractors and Owners are, for example, making one exterior finish Contractor such as the mason or EIFS installer responsible for all of the envelope elements beneath that finish, outside of the structural elements.

1.3.4 Contract Review - Building Envelope Amendments

Items pertaining to the building envelope specification and building maintenance requirements include:

1./reliability, serviceability and maintainability requirements;
2./permissible deviations, alternatives and substitutions;
3./building envelope acceptance/rejection criteria;
4./appropriate staging of the erection process resulting in readiness for work performed by other trades;
5./installability;
6./aesthetic specifications and acceptance criteria ;(quality of finish, excessive gaps and clearances, etc.)
7./ability to diagnose and correct problems at the stage when correcting them is economical;
8./use of approved materials and components

Note all building envelope amendments to contract agreements, including:

a) change of customer requirements

Items pertaining to customer needs and satisfaction include:

1./identification of customer needs expressed through technical specifications
2./validation of the design through prototype tests (mock-ups, scale models)
3./durability under expected conditions of use and environmental aspects of coastal British Columbia
4./consideration of unintended uses and misuses
5./compliance with regulatory requirements and related standards
6./consideration of problem history to avoid repeating problems with durability of building envelopes

b) resolved ambiguities or differences
c) modifications to specified and agreed requirements

1.3.5 Contract Review - Records

Maintained the following records of Contract Review :

Item	Name	Responsibility
1.3.6.1/	Contract Review	Contractor's Sales Representative
1.3.6.2/	Contract / Tender files	Contractor's Sales Representative / Site Superintendent
1.3.6.3/	Project files	Site Superintendent

1.3.7 Contract Review - Balancing Quality and Cost

Every Project is a balance between quality and cost considerations. Building envelope performance is usually improved where increased costs are acceptable. The Contract Review phase is probably the first time on each Project where the Quality/Cost equation is addressed.

Indicate who within the Bidder's organization is responsible for resolving Quality/Cost conflicts/ issues.

Whenever a Bidder's QMR or other personnel preparing a Bid discover an element of the Bid Documents which does not appear to satisfy Building Envelope Quality/Cost Criteria for a specific Project, refer this information to the Bidder's company-wide QMR who will:

a) Confirm whether or not the element appear to satisfy Building Envelope Quality/Cost Criteria for the Project;

b) Determine if the element should be reviewed with the Bid Document preparer during the tender period;

c) If so, contact the Bid Document preparer's QMR to review the element in question;

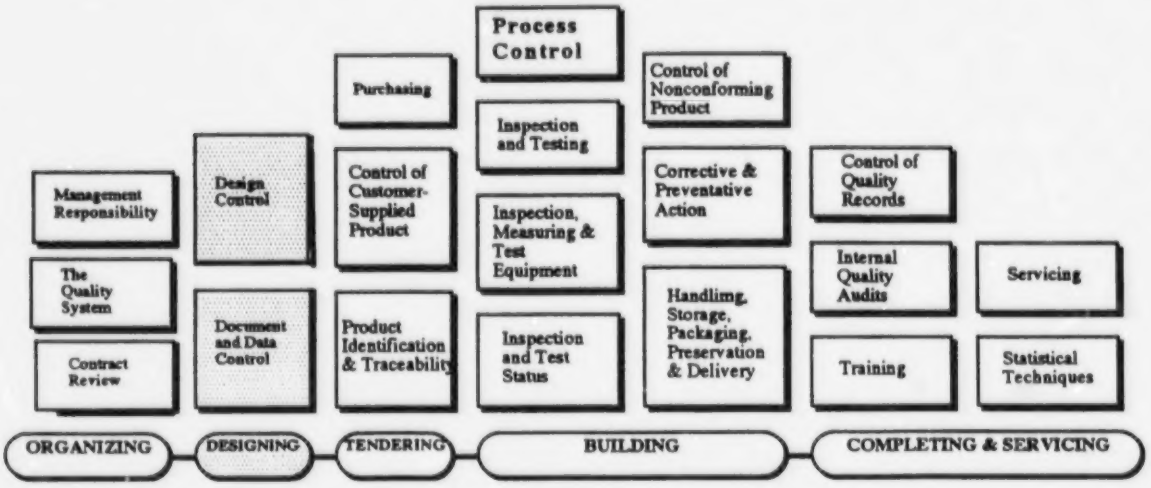
d) Clarify the status of the element in question by:

   i) Noting the altered Quality/Cost Balance on the Tender; or

   ii) Securing an amendment to the Bid Documents clarifying the anomaly; or

   iii) Securing approval for an alternative or substituted product which better meets the Quality/Cost criteria

Chapter 2. DESIGNING FOR QUALITY



THE QUALITY ASSURANCE PYRAMID

INTRODUCTION[1]

Purposes of This Section -
1. To ensure that a project design meets the building envelope requirements of the Client, the end users and society at large.
2. To assist in the development and maintenance of appropriate building envelope document and data control for Designers, Builders, Suppliers and Installers.

What is Building Envelope Design Control? - It occurs throughout the design phase, and may influence programming, concept planning and design, site planning and detailed design and design development. For the purpose of this Manual, Building Envelope Design Control is defined as *procedures incorporated in the project's design phase in support of appropriate building envelope design, performed by authorized Designers' personnel.* These activities provide documented input for formal verification and approval by the Client, the Designers and others as appropriate. It may be that some design control procedures involve specialist consultants or regulatory agencies such as building officials.

What is Document & data control ? - A well-organized Building Envelope Provider needs a document and data control system to ensure that appropriate documents are available wherever they are essential and that any changes to these documents are recorded. Document and data control systems should include documents essential to the design, construction, assembly, inspection, review and commissioning of a building envelope. Related procedures specify how controlled documents and data are controlled, who is in control, what is to be controlled, where and when.

A properly managed document control system should include guidelines for:
- storage conditions to minimize deterioration and prevent document or data loss.
- control of electronic controlled documents and data
- a controlled documents master list
- defined document change authority
- access to controlled documents
- controlled documents retention time
- obsolete controlled documents and data identification

The Building Envelope Provider may also define specific policies concerning:
- availability and access of records to the Customers and Suppliers.
- control and identification of changes in regard to various types of documents.

What is the Main Purpose of Building Envelope Design Control? - To enable the Designer to establish appropriate building envelope design requirements, implement them throughout the design process and obtain appropriate and necessary approvals during and at the completion of the design process.

What is the Main Purpose of Document & data control ? - The quality management system should establish guidelines which will govern document and data control. These guidelines shall define means and methods of identification, collection, indexing, filling, storage, maintenance, retrieval and disposition of pertinent quality documentation and records.

Key concepts -

- Every Project needs a defined **Water Management Strategy** - that is, a series of concepts and details specifically focused on keeping exterior water out while facilitating the removal of exterior water which inadvertently gets inside the building envelope.
- Deviations from **Best Practice Guide** details should be verified during the design process, so that valid deviations based on improved/alternative technology are welcomed, unique design is accommodated but without sacrificing the "best" content of BPG details.
- Effective building envelope design continues throughout the construction stage. It is well understood that because even complete working drawings and specifications generally permit specific choices of systems and products as well as allowing for alternatives and substitutions, they do not constitute final design drawings - hence the emerging requirement for record drawings, which are defined as final design drawings.
- **Mock-up's** are an essential component of the process. Experience has shown that when the full complement of selected materials and systems arrives on site, adjustments are essential.

- Controlled documents and data can be in the form of any type of media, such as hard copy or electronic media.
- Change constitutes unavoidable part of the building projects. Changes to controlled documents and data should be reviewed and approved only by authorized personnel.
- Whenever practical, the nature of document changes shall be identified on the documents or the appropriate attachments. This requirement applies also to changes, modifications, revisions or additions to the contents of the Quality Manual.

Values of this Section - This record of design responsibility, combined with other records and procedures in this Section and other sections of the Quality Manual provide vital insight into both building envelope design intentions and the execution of those intentions in regards to the building envelope. Their existence may help in circumstances when the building envelope is blamed for warranty or post warranty problems and, in particular, when customer complaints have to be resolved through arbitration. Building Envelope Design Control may be required to comply with local or provincial building and other regulations and may necessitate formal endorsement by authorized regulatory agencies.

Control of design and construction documents constitutes the most critical part of evidence required as proof that a quality system has been effectively implemented. Implementing these recommendations will reduce the incidence of design and construction errors and will improve the efficiency of all parties in monitoring design and construction progress.

Q-Tips - are suggestions, tricks, and experiences which may assist in the application of the Quality Assurance Protocol are inserted where appropriate in this Section in the form of *Q-Tips* - comments enclosed in boxes like this one.

Q-Tip - **BUILDING BETTER IN VANCOUVER**[2] - It has been estimated that there are more than sixty climates in North America.[3] Vancouver's has been well described in the Vancouver Building By-Law, others throughout British Columbia are described in the Supplements to the National Building Code and from local meteorological data. This sort of basic data, taken together with CMHC's evaluation of building failures, the Best Practices Guides and one's own experience and building science knowledge, can be summarized in a general document which might help guide Designers at the earlier stages of a project. The master document can be annotated with information about preferred envelope system alternatives, etc., then edited to suit a particular project. It would also serve as a useful record of the climatic assumptions underlying a design, which may become more important in the face of the significant climatic changes we appear to be experiencing.

2.1. Purpose of Design Control

To ensure that design activities follow documented and maintained procedures in order to meet requirements such as those:

a) described in CMHC's " Quality Assurance Protocol for the Exterior of Wood Frame Multi-Residential Buildings" (hereafter called 'QAP') of which this Manual is an integral part.

b) defined in the "Best Practice Guide for Wood Frame Construction in the Coastal Climate of British Columbia" (hereafter called 'BPG')

c) defined quality intentions and maintenance expectations of Owners and Occupants as defined during contract agreement and review phases.

As discussed in Chapter 1

These requirements are in addition to the standard requirements which are:

d) specified in contractual agreements, and

e) reflected in product specifications

f) inherent in the requirements of regulatory agencies

g) inherent in the standards referenced by materials and products

Q-Tip **- Specifications -** One pundit has stated to us that specifications are only read in court. Setting aside the whole issue of specification format (see Q-tip below), perhaps Designer specifications should include editorial comment along the lines of the commentary which is supposed to be edited out of master documents like the NMS specifications. Why not include some educational content in specs., especially during the transition period to a quality assurance protocol? Perhaps a separate font treatment such as the *italics* used in this document, or the Q-tip boxes, could differentiate between specifications and education, Food for thought.

2.2. Purpose of Document and Data Control

The Purpose of this Section is to describe the Building Envelope Provider's document control policy in order to ensure that documents directly affecting the quality of the building envelope are properly documented, reviewed, approved, distributed and filed.

This procedure applies to both internal and external controlled documents and data, disregarding their origin or type of media, and includes engineering drawings, specifications, standards, building codes and regulations, where applicable.

Internal controlled documents include things like one's own contracts and purchase orders, design documents, etc. External controlled documents include things like municipal assurance letters, building codes, etc.

Classify documents pertaining to the quality of the design, quality assurance and quality control as either:

a) Controlled documents - these documents and/or their copies, which are subjected to control of their issue, review, approval, change and distribution.

Good examples are shop drawings and tender documents.

OR

b) Non-controlled documents - these controlled documents and data which as such are not classified as controlled documents or represent non-controlled copies of the controlled documents which are provided for reference purposes only.

Good examples might include initial sketch designs which are subsequently replaced by formal documents, drafts of formal documents, etc. Obviously, each Building Envelope Provider will need to establish the limits of each category depending on perceived control and record needs.

2.3. Building Envelope Design Planning

Clearly identify on the Building Envelope Portion of the Quality Plan[4] those design stages where decisions affecting the integrity of the building envelope occur, including specific project deadlines and milestones.

Building envelope considerations arise during the following phases or stages of design:

NOTE: novel or unusual items important to building envelope integrity are italicized in bold type like this.

2.3.1. Schematic Design

a) liaising with the customer in design-related matters

i) establishing the expected life of the project in terms of years, generations or mortgages.

ii) establishing expected maintenance approaches, i.e., resident caretaker vs. property management company vs. self-maintained.

b) Review of programming information

i) specific programmatic requirements which impact on building envelope design, e.g., high humidity environments, special ventilation requirements, etc.

c) Establishment of a basic design concept

i) zoning impacts, i.e., design guidelines, general zoning regulations affecting overhangs, etc.

ii) marketing and stylistic impacts, i.e., importing a design "look" which originates in another climate

iii) development of a basic design concept for the project.

The "story" of the design

Q-Tip **- The Story of the Design -**

Traditionally, each member of a design team takes basic instructions from the Client and Coordinating Registered Professional, then proceeds to design those aspects encompassing their expertise. "Coordination" consists of (sometimes hit and miss) meetings wherein everyone's conflicts are (hopefully) worked out. The building envelope is seldom analyzed except in basic mechanical engineering terms.

An alternative approach would be to require each team member to first describe in lay terms their conceptual approach to their portion of the project design, for review with the entire team. Often, basic conflicts in approach exist and may be flushed out by this approach. Potentially conflicting approaches in terms of building code and building envelope may be identified and resolved or identified as challenges. As an example, we discovered on one of our building science projects that the Architect and mechanical engineer each had different and conflicting views about where the interface between interior and exterior spaces lies. An early exploration of the building's "story" might have uncovered this kind of potentially serious inconsistency.

The story of the building should be initially assembled by the CRP for "sign-off" by the owner. This document would also be useful for any consultant dealing in a variety of ways, e.g., engineers interfacing with city utilities depts., architects with city planners and building officials, etc.

Basically, the story of the building would set the groundwork for each participant.

The story should be short enough to fit on one sheet of paper, so each participant can literally pin it to his/her work station and can attach it to a variety of other supporting documentation.

As a check on quality assurance, one would agree that any problems with the story, or proposed amendments, would be treated like Change Orders, i.e., circulated to all for review and comment as to quality, time and budget (hard and soft) implications. The designated parties could sign off revisions for circulation to all concerned.

This may sound a bit ponderous, but it would eliminate a host of downstream problems and always keep the team current on the overall concepts.

2.3.2. Design Development

a) selection of building envelope materials and finishing systems

i) Basic cladding concepts and a water management strategy

Q-Tip - **The Water Management Strategy** - Many building leaks arise from discontinuous water paths. In short, water is picked up by a gutter, drain or scupper, then unceremoniously dumped on the ground (over habitable space) or another roof (causing premature wear to the roofing materials) or worst of all, somewhere on the building face.
To avoid these type of leaks, determine the path of water hitting any roof or wall of the building, from the point of impact to the storm water drainage system. Typically, discontinuities become quickly obvious and may then be resolved.

ii) Interface conditions between materials

Q-Tip - **There are only 5 good house plans and 30 key details!** - We have identified 30 generic detailing conditions which encompass all but the most unusual design configurations of typical wood frame building envelopes. The 30 include below grade, at grade, intermediate floor and roofing conditions, flat and sloped roofs, with/without skylights, balconies, overhangs, mechanical penetrations, open walkways, etc. As a minimum, design development should identify which of the 30 apply to a specific project, as well as any "non-generic" variations. The details not identified and detailed at this stage will become the "Requests for Information", "Changes to the Work" and worse at later phases of the Project.

As to the five good house plans, all the rest are variations on the five themes - or they don't work!

iii) appropriateness of materials and systems for the selected designs
It is at this stage that the developing design will benefit from BPG details. Refer to the Forms Section of the Protocol for a form which records variations from the BPG details in the proposed design, with reasons. This record has two functions: a) forcing the Designer to evaluate the applicability of BPG details and principles to a specific design; b) validating deviations such that if a problem develops in future, the Designer's rationale is evident.

b) selection and communication of structural, mechanical, electrical and other engineering systems
i) Dimension vs. engineered systems
ii) Sheathing materials
iii) Balcony and walkway systems
iv) Horizontal vs. vertical exhaust
v) integration of engineering systems into overall system descriptions
The "story" of the systems

2.3.3. Working Drawings and specifications

a) Maintenance of earlier concepts through working drawings
i) Details which can be effectively read on site
This requirements tends to favour details on 8-1/2 x 11 or smaller paper.

Q-Tips - **Timely Details**- One of our favourite site superintendents plans each day's activity at the end of the preceding day. This includes picking out which drawing details are needed for reference the next day and xeroxing them. Next morning he distributes these details to the crews, who carry them off to their work area, post them, refer to them and ultimately abandon them at the day's end, only to have the process repeated the following morning. For the cost of a rented xerox copier and a few reams of paper, the superintendent keeps the right information in front of his workers.

Q-Tips - **Educational Details** - Although there is still debate over whether it is appropriate for designers to show sequencing of work on their drawings, our evidence is that this approach helps immensely. Often, apparently minor changes to sequencing makes major gains in construction efficiency, which efficiency usually translates into a more sound building envelope. As a variation on the 8-1/2x11 detail sheet, consider 11x17, with the drafting on 1/2 of the sheet, the other 1/2 devoted to explanatory notes, sequencing information, specs., etc. Fold the 11x17 in 1/2 and you have an 8-1/2 x 11 module suitable for a binder, with drawing on one side and supplemental data on the back. Laminate the 8-1/2 x 11 and you have a durable item for the workplace, with the plastic surfaces suitable for markup with adjustments, comments, etc. Collect the marked up sheets and you have a) record drawings and b) a free education on how to improve the details. Give credit (or better, bonuses) to workers who communicate a better way to do the job and you have constantly improving standards and increased respect and co-operation from the workers.

b) appropriate specifications for building envelope design intent

i) Specification which can be effectively read on site

Most engineering specifications are now placed on drawings, which appears to improve their likelihood of being read. Perhaps the stand alone specification is passé.

Q-Tips - **OUTLINE SPECIFICATIONS** - This document has been written in an outline format, which allows for easy movement of large blocks of related text, etc. Specifications may be organized similarly. In lieu of a large number of discrete documents, a master specification can be organized as a single outline document, with the traditional 16 Divisions as 16 outline Sections, and what would ordinarily be the various specification sections as subsections in the outline. The advantages of this approach include: a) a single source for specification information (ours is about 350k in size and loads in 20 seconds); b)update and new information kept in one location; c) easy reorganization and renumbering via word processing software commands (We use MS Word for Mac - a full specification will renumber in about 1 minute, and generate its own Table of Contents in another).

2.3.4. Construction Documents

a) Maintenance of earlier concepts through the construction phase

b) Mockups

i) detailing and documenting resulting design adjustments

Mock-up's need to be designed as much as buildings, in order to include all o most critical interfaces and material combinations.

Q-Tips - **Some Tips on Mock Ups**- to be included on drawings and specifications

- Have them built by the same people who will do the work on the real building - otherwise, the entire effort is wasted;
- Design mockups like any aspect of the design - select not only the location(s) where complexity of material and/or construction planes requires careful consideration, but also "typical" window, door and mechanical openings, which account for the highest proportion of envelope failures by far;
- Note in specs. and at initial site meetings the requirement to accelerate fabrication and delivery of components such as sample windows, doors, mechanical exhausts, etc.
- Test mock up's for performance "in place". Many components and their interfaces will fail first time 'round.
- Repeat testing on later work product - check the last in as well as the first in, to confirm ongoing conformance. Even better if later tests are random.

c) Alternatives and substitutions

i) Qualifying materials

Refer to the Forms section of this Protocol for a Submittal Review form which also encompasses alternatives and substitutions.

Poorly researched and/or evaluated alternatives and substitutions in construction are one of the main causes of building envelope failure. The Submittal Review form in the Forms Section of the Manual is deliberately exhaustive and onerous. Everything requested on it is important to proper building envelope evaluation, and we strongly recommend refusing to approve proposals which are deficient in content or presentation.

Q-Tips - **A Materials Hit List and a List of Material Hits -** There's no time like the present to start a matrix of acceptable building envelope materials as they relate to compatible and incompatible neighbours. Unfortunately, some manufacturer claims about longevity and cohabitation are poorly researched. For example, we have tested self adhering adhesives (peel & stick) and sealant combinations which manufactures' literature indicates are compatible, only to find almost immediate failure. Conversely, some materials perform much better than advertised. Applier beware!

d) Changes to the work
   i) Formal changes via Site Instructions and Change Orders
   ii) Informal changes via other authorized or unauthorized means.

The control of unauthorized changes is a key to preserving the integrity of the building envelope design.

Q-Tips - **Four Kinds of Change -** The standard construction industry contract describes 4 kinds of change to the Work : Site instructions; Change Directives; Contemplated Change Orders; and Change Orders. Each is used depending on the circumstances, but there are only 4 circumstances. We use one master spread sheet form for all, simply crossing out the change types which do not apply. We are prompted to fill in data about location, reason, drawing/spec. references, costs, schedule changes, etc. Our rule is: if it's not published as one of these four, it doesn't exist. Most Contractors applaud that clarity and co-operate with it. There is no reason Builders could not adopt the same type of approach to Changes.

2.3.5. Commissioning

l) Preparation of Building Envelope Record Drawings (i.e., Final Design Drawings)
   i) for records by regulatory agencies
   ii) for use by consumers.

Q-Tips - **"AS INHABITED" DRAWINGS** - Most Building Envelope Providers know what "as built" drawings are. However, most building owners and occupants do not, nor do they necessarily have access to as-built's. If as-built's are also annotated as to any variations in building envelope materials (e.g., peel & stick type 1 on the north face, type 2 on the south), then a set of these could become resource drawings for occupants for any post completion maintenance and repair work. These "as inhabited"'s are especially useful when records of building envelope changes, leaks, etc. are noted right on the drawings. Sometimes patterns emerge which may help discover the source of apparent leakage or failure of the building envelope.

2.4. Design Input

Design input includes all of the factors and information which the Designer analyzes, then integrates into a design.

Document and review design input requirements for adequacy at planned design stages. The stages which are important as regards building envelope design include:

a) identification of customer requirements
   i) expectations regarding durability and longevity
   ii) preferred building envelope materials and/or finishes
b) receipt of customer drawings and technical documentation
   i) customer designs and other requirements may affect building envelope integrity

   Where customer requirements may affect envelope integrity, the situation should be reviewed with the customer and if the resolution if not satisfactory, this should be noted won the appropriate BPG variance form.
c) review of related standards and regulatory requirements
   i) materials and forms mandated by planning authorities, such as in design guidelines

   NOTE: Elsewhere in this Quality Manual the concept of analyzing variations from BPG details is introduced. It is perfectly reasonable to include the requirements of planning authorities as a reason for varying from BPG details.
   ii) The BPG and Part 5 of the VBBL/BCBC

   Refer to the Forms Section of this Protocol for a building envelope design review meeting agenda template.
d) environmental conditions
   i) particular exposures to the elements
e) experience gained during development of previous similar designs

   This is where the value of records comes into play.

Design input activities are intended to resolve incomplete, conflicting and/or unclear requirements.

Design input data may be summarized in the form of The Building Story, discussed in a previous Q-Tip.

As a minimum building envelope design control measure, each Designer would describe their design in terms of these building envelope considerations - **the 4 D's**:

2.4.1. Deflection

The removal of moisture from the envelope before it impacts on more vulnerable surfaces;

2.4.2. Drainage

The removal of moisture from within the building envelope

Includes removal from within the envelope, on the conservative assumption there will always be leakage over time

2.4.3. Drying

Means to dry out the building envelope, both on outside surfaces and within assemblies

2.4.4. Durability

Determination of component and assembly longevity, plus maintenance requirements to preserve and extend service life.

2.5. Design Output

Design output includes all of the materials which describe a Project design, such as drawings, specifications, schedules, shop drawings, etc.

Design output criteria should match design input requirements and are reflected in:

1. design drawings for tender and construction

a) Technical Specifications

b) Shop Drawings[5]

Design output documents should be formatted to facilitate the communication of building envelope information to Builders, Suppliers and Installers.

This Quality Manual contains a number of suggestions regarding communication of this information.

2.6. Design Review

The Quality Plan shall include a schedule for design reviews at designated stages of the project. These activities shall be conducted at defined intervals. Design review takes place during Coordination Meetings attended by Quality Management Representatives and Designers of all parties affected by the design development process. Coordination Meetings Minutes are maintained.

2.7. Design Verification - SIGN-OFF

Design Verification (a.k.a. Sign-off) occurs at various design stages defined in the Design Plan, including:

1. for each detail, when evaluated against the BPG details;

a) prior to issuance of documents for each Design Review Stage

b) prior of issuance of documents for permit application, for tender and for construction

c) prior to issuance of documents for "as built", "as inhabited" or record purposes.

Q-Tips - **DESIGN VERIFICATION "in the margins"** - The prevalence of computer aided design and the resulting continuity of design documentation from concept design through record drawings affords an opportunity to record design verifications. Some firms print long, narrow charts along binding edges of drawings, allowing the design verifier to affix initials at the appropriate phase. The number of opportunities is only limited by the length of the margin and the size of the review budget. The comments immediately above suggest a minimum of nine occasions: BPG/ at least 1 internal design review/ planning permission/ building permission/ tender/ construction/ as-built/ as-inhabited/ record. The Client should sign off at the BPG/planning/building/tender/construction phases as a minimum.

2.8. Design Validation - MOCKUPS & SUBMITTALS

Design Validation complements Design Verification activities (as described above) aiming at confirmation that the final building envelope meets specifications.

The Contractor is generally responsible for design validation, which is performed during construction by:

1. site evaluation with the customer and designer, e.g., mockups;

a) Submittals to the designer, including shop drawings, samples, manufacturers' literature, etc.

Records of design validation shall be maintained.

2.9. Design Changes[6]

Design changes and modifications introduced during the design development process are identified, described in related documentation, reviewed and approved by authorized personnel prior to their release. Design change control follows guidelines applicable to document and data control (Refer to Section 4.5 of this Manual).

Changes to design documentation and data shall contain, where applicable:

1. clear identification of changes

a) appropriate endorsements and permits

2.10. Design Control: Records[7]

The following design records shall be maintained:

	Item	Name	Responsibility
2.10.1.	1/	**Quality Plan**	**QMR**
2.10.2.	2/	**Design Drawings and Data**	**Designer**
2.10.3.	3/	**Project Files**	**Designer**
2.10.4.	4/	**Designer Meeting Minutes**	**Designer**

2.11. Document and Data Control: Responsibility

Each person charged below with responsibility for document or data control shall ensure that each document provided by it, including supplies and fabricated elements,

includes contact information for the associated Quality Management Representative (QMR).

It is essential that any person with a quality assurance mandate be able to contact any other document/data provider .

2.11.1. Designers: The Quality Management Representative (QMR) for each Designer shall be responsible for all controlled documents pertaining to

a) best practices and any variations or modifications thereto

b) quality control during the design process

c) building envelope quality verification during the permitting, construction and commissioning phases

d) quality assurance verification at project completion.

2.11.1.1. Builders : The Quality Management Representative (QMR) on site for each Builder shall be responsible for all controlled documents pertaining to

e) best practices implementation and any associated difficulties

Basically, the Builder QMR identifies situations where best practices do not appear possible, for review by Designers.

f) quality control during the construction process including issuance of work instructions

g) building envelope quality verification during the trade permitting, construction and commissioning phases

This will involve the supply of a variety of warranties and guarantees confirming the quality of specified products and installations,

h) quality assurance verification at project completion.

This will include completion of identified deficiencies

i) quality assurance warranty

This currently involves the one year warranty inspection and remediation of discovered deficiencies. Warranty requirements are under discussion at the industry/government levels and may change in the near future.

2.11.1.2. Suppliers: The Quality Management Representative (QMR) for each Supplier shall be responsible for all controlled documents pertaining to

a) best practices, including interfaces between supplied materials and materials supplied by others

b) quality control of the fabrication of the supplied materials

c) selection and delivery of supplied materials, especially that supplied materials match purchase orders and construction documents

d) supply of sufficient information with delivered materials to provide for building envelope quality verification for supplied materials

This typically includes application instructions, storage instructions, warnings about handling and installation, etc.

e) quality assurance

f) quality assurance warranty

This currently involves various warranty terms and conditions. Warranty requirements are under discussion at the industry/government levels and may change in the near future.

2.11.1.3. Installers: The Quality Management Representative (QMR) for each Installer shall be responsible for all controlled documents pertaining to

a) best practices, both traditional to a Trade and as recommended by the Best Practices Guide

The most critical identified deficiencies in this area relate to sequencing of work and appropriate provision for penetrations and similar envelope disruptions.

b) quality control of installations

c) building envelope quality verification as related to a specific installation

d) quality assurance

e) quality assurance warranty

This currently involves the one year warranty inspection and remediation of discovered deficiencies. Warranty requirements are under discussion at the industry/government levels and may change in the near future.

2.12. Document and Data Control: Procedure

The general guidelines below for document control shall be followed:

2.12.1. A Controlled Documents Log shall be established and maintained.

Refer to the Forms Section of the Quality Manual for a suggested format for this Log.

2.12.1.1. All copies of controlled documents shall be identified with a "Controlled Document" stamp or similar identification

Refer to the Forms Section of the Quality Manual for suggested wording of such a stamp.

2.12.1.2. Only authorized and the most current versions of the relevant controlled documents and data shall be used

"Authorized" identification should be as established between the QMR's for the various Building Envelope Providers to a Project.

Use the Controlled Documents Log to determine the most current version of a document.

2.12.1.3. Invalid or obsolete documents shall be removed from all points of use or clearly identified.

It may be necessary to retain certain obsolete documents for contract record purposes and similar.

2.13. Controlled documents and data: Approval and Issue

The Building Envelope Provider policy regarding controlled documents is as follows:

1. Documents shall be free from unauthorized notations and changes. Distribution of the controlled documents and/or data shall be documented in the Document Distribution portion of the Log.

In some instances and project scales, all Log contents may perhaps be registered on the Contract documents. Many Designers already use "Document Issue" and "Revision" columns to incorporate some control measures.

Q-Tip - **HIGHLIGHTING REVISIONS** - There is a long-standing practice of using tiny triangles to indicate areas of drawings which have been amended. Finding these triangles and discerning the extend of revisions is a frustrating process and if the indications are too obscure, important revision information will be missed. A superior practice is to "cloud" the revised area with a hand-drawn cloud or bubble, to which the revision triangle is attached. Most CAD systems allow this to be done electronically and using layering techniques, successive revisions may be temporarily hidden so that only the current issue of revisions is visibly highlighted.. As a bonus, these more obvious revision indications make the preparation of Project records documents much easier in future, as all "layers" of revisions may be simultaneously made visible.

7.10.1.1 Status/issue of the controlled documents/data shall be always properly identified.

See Q-Tip above

a) Original document (original copy) records shall be maintained by the originator.

See Q-Tip above.

2.14. Controlled documents and data - Changes and Modifications

See also Q-Tip above

1. Revised document/data shall be reviewed and endorsed by the authorized personnel responsible for issue and control of the original document.

This suggests the Log and/or the actual document should have a location for the issuer's "approved for issue" initials.

Where the person responsible for the original document is not the QMR, then the QMR should also initial "approved for issue".

7.11.1.1 Information regarding document/data nature of change, issue and date of issue shall be provided.

See the Log in the Forms Section of this Manual.

a) Nature of the change of the controlled document shall be identified.

We have found no problem (space permitting) with the ides of affixing to the "cloud" surrounding revisions a note describing the nature/reasons for a change.

2.15. Document and Data Control - Records

Controlled documents should be properly identified and authorized. All changes to controlled documents and data should be documented and recorded. Current issues of controlled documents shall be available at all locations where operations essential to the effective functioning of the quality system are performed.

Traditional hierarchical organizations often have a list of authorized signatures required on a document. These authorization lists are usually organized by hierarchy so that each successive reviewer can see that the more junior reviewer has authorized issue. Authority may carry monetary limits, permitting document issue with a reduced "sign off" requirement, depending on associated costs.

Controlled documents and data should be legible, dated, clean, readily identifiable to a specific project and to the relevant stages of the building envelope construction process, and maintained in an orderly manner. A method for obsolete documents identification and/or disposal shall be defined and followed. This applies to both hard copy and electronic controlled documents and data.

Quality Manual users may wish to consult relevant legal consultants for advice here, and/or professional and trade organizations.

The following records of Document and Data Control, either manual or electronic, shall be maintained:

2.16.	Item	Name	Responsibility
	2.16.1./ Representative	Controlled Documents Log	QM
	2/	Document Distribution Log	QM Representative
	3/	Controlled Document Stamp	QM Representative

2.17. Organizational Interfaces

The Principal Design Consultants have allocated responsibility for the coordination of professional services provided by all Designers to a **Coordinating Registered Professional (CRP)**. The CRP may or may not be the Quality Management Representative (**QMR**) for the Principal Design Consultants.

Each of the Designers and Builders have allocated responsibility for design and product development to qualified and competent personnel.

Each Building Envelope Provider has nominated a QMR for the project.

Specific responsibilities are defined in personnel job descriptions and include:

a) evaluating and documenting the application of Best Practices to a specific design
b) liaising with the customer in design-related matters
c) developing and controlling drawings and data
d) obtaining design verification (Sign-off) by the customer
e) preparing documentation for regulatory approvals , tendering and construction.

The responsibility, authority and interrelation of personnel contributing to the design control process are reflected in the Design Control portion of the Project Quality Plan, which is reproduced below and footnoted with fill-in information.

The DRM may be used by anyone with any design responsibility, whether for tender documents, shop drawings, specialized consultants' drawings., etc.

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1 Each section of the Quality Manual will have an highlighted/ boxed introduction, designed to explain to the reader/ user the function of the specific section.

2 © COPYRIGHT 1998 Pro Pacific Architecture Limited.

3 Comments by Joe Tsiburek at a lecture in Vancouver to BCBEC, 1997.

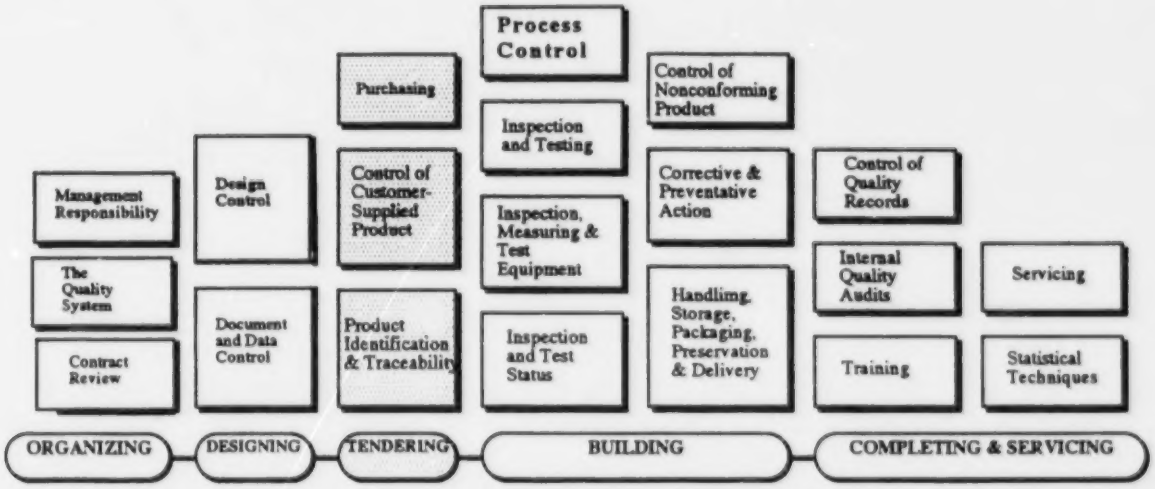
4 Refer to Section 4.1 of the Quality Manual for information regarding the Quality Plan.

5 Where this Section is adapted for Contractor/ subcontractor/ supplier use, the Design Responsibility matrix and similar documents would be modified to reflect the viewpoint and requirements of the Designers working for these companies.

6 This text needs more work.

7 The Manual may eventually specify more detailed records or records customized by the individual user. These are the bare minimum per ISO

Chapter 3. BUYING QUALITY



THE QUALITY ASSURANCE PYRAMID

INTRODUCTION

Contrary to popular myth, quality is not free, and the first cost of assured quality goods or services performed by a reliable subcontractor may appear to be higher than the best deal available on the open marketplace. However, good quality often costs less. The bonus comes in the form of the reduced overall costs of completed work due to increased productivity and reduced losses resulting from the minimal interim rework and warranty repairs.

Purposes of this Chapter

Materials and components purchased by a Contractor affect the quality of the building envelope. Also, the quality of subcontracted services required for the completion of the building envelope will have a direct influence on the durability of the finished structure. **This chapter addresses how to inject quality considerations into the purchasing of materials, systems and services alike.**

A Building Envelope Provider must assure himself that **Customer-supplied product is suitable** for its purpose/use and that the outcome of services subcontracted by the Customer to another Provider fulfills Customer requirements and expectations. **This chapter identifies methods of assessing customer-supplied products**

Many deficiencies in building construction arise from **unwarranted or inplanned alternatives and substitutions during construction.** This chapter introduces the importance of identifying and tracing products and services in the building envelope, both to reduce errors in initial construction and make traceability of problems easier, hence improve the abiltiy to repair latent defects.

What is Customer supplied product? In some cases specific components of a building envelope may be supplied by the Customer for incorporation into the final product. Occasionally the Customer (Investor, General Contractor, etc.) may also subcontract specific parts of work involved in the building envelope construction process beyond the scope of an agreement with the Builder, but the Builder remains directly responsible for the quality of the completed work.

What is the Main Purpose of Product Identification and Traceability ? - From the time of goods receipt to the point of their usage, the identity of materials, components and assemblies etc., should be maintained in order to prevent accidental or inappropriate use. All too frequently purchased products or components are "lost" at the building site or within the system through lack of proper identification. Sometimes this results in inappropriate substitutions.

Key Concepts -

- The broad statement that "everything affects quality" gains particular meaning when related to the quality of purchased goods and services.
- A properly defined quality system shall also consider auxiliary services employed by the Builder such as transportation, communication, accommodation, equipment rental, calibration of equipment (if any), etc.
- Improved quality in auxiliary services will translate into a better balance between cost and quality.
- In general there is no difference between the role of the Customer and the role of the Suppliers & installers to the Builder. In both cases quality of the received product should be assured and verified in line with contract requirements and guidelines provide in the Quality Manual.

Quality Manual Approach - A properly defined procurement program should include the following elements as a minimum:

- a defined purchase order procedure
- a method of sourcing of purchased goods and services from qualified supplier/subcontractors;
- agreed quality verification criteria
- provisions for settlement of quality disputes;
- control of purchasing records

Properly structured quality assurance provisions in purchasing should be commensurate with the needs and nature of the Builder's, Suppliers' and Installers' businesses and should avoid unnecessary costs. In certain cases, formal quality assurance systems may be required of the Suppliers or Installers. This may include periodic assessment by the Builder or Customer's Quality Management Representative.

In line with generally accepted quality practices the Building Envelope Provider shall verify the quality of Customer-supplied product provided for incorporation into the building envelope. The Building Envelope Provider also remains responsible for storage and interim maintenance of product provided by the Customer (Investor or General Contractor). If the quality of customer-provided product is found not to conform to specified requirements or if product is lost, damaged or is otherwise unsuitable for use, this shall be recorded and reported to the Customer.

The Building Envelope Provider may choose from the following arrangements for the Customer-supplied product quality verification purposes:

a) Specify, document and implement unique methods for Customer-supplied product verification
b) use the methodology defined in this Quality Manual to verify the quality of any purchased
product or subcontracted services
c) use any combination of the above

Whenever applicable, the Building Envelope Provider shall establish and document methods for identification and traceability of materials and/or components during all stages of building envelope construction, assembly and related installation work. The Building Envelope Provider shall describe both the manner in which materials, products (including provided services) or prefabricated components are identified. The method employed to maintain batch (product, service) identity right through until the final quality has to be also determined.

The extent of identification and traceability shall depend on requirements defined by the Customer and regulations applicable to the building envelope. Additionally utilized methods of building envelope identification and traceability shall address needs of specific building site dictated by site arrangement, sequence of building envelope assembly, etc. In some circumstances unique identification and traceable records of individual product or batches may be necessary.

Specifically, whenever purchased products or prefabricated building envelope components are released for construction or assembly purposes, their identification shall be recorded in order to permit rework or replacement in the event of nonconformance to specified requirements.

Also in cases when corrective or preventive action was introduced in-process, it may be advantageous to document the point at which this action was commenced in order to assist in the evaluation of corrective action effectiveness.

Values of this Section - Close working relationships established between the Builder, Suppliers and Installers creates a more desirable work environment in which continual quality improvement activities can be maintained and quality disputes avoided or settled quickly.

Adherence to these guidelines is in the Building Envelope Provider's vital interest, as the verification of supplied product quality by the Building Envelope Provider does not in any way absolve the Customer of the responsibility to provide acceptable product. A clear understanding should be developed between the Building Envelope Provider and the Customer on quality assurance for which the Customer is responsible. This may be reflected in proper clauses constituting integral part of the contractual agreement.

Q-Tips - are suggestions, tricks, and experiences which may assist in the application of the Quality Assurance Protocol are inserted where appropriate in this Chapter in the form of *Q-Tips* - comments enclosed in boxes like this one.

3.1. Purchasing

3.1.1. Purchasing: Purpose and Definition

The guidelines contained in this Section of the Quality Manual are intended to ensure that:

- goods and services purchased by a Contractor conform to specified quality requirements
- purchasing activities are conducted according to documented procedures

This Procedure applies to:

- purchased materials,
- components,
- construction and inspection equipment,
- sub-contracted services and
- consumables (paints, resins, glues, fillers, oils, greases, etc.)

all as required for construction of the building envelope and for related quality verification purposes.

3.1.2. Purchasing: Responsibility

The Builder, Supplier and/or Installer personnel with responsibility for procurement of goods and services required for construction of the building envelope ensure compliance with all relevant procedures related to purchasing activities.

This is typically the Site Superintendent. Many sophisticated Builders still afford their site superintendents great latitude in material/ system selection and procurement. The downside of this occurs when the site superintendent assumes that authority allows convenient substitutions "on the fly". Even this may be acceptable if there is a procedure for evaluating "on the fly" proposals for substitution.

The Quality Management Representative (QMR) is responsible for verification of the quality of the purchased product.

This is typically the Project Manager or in some cases, the Purchasing Manager

Unless otherwise advised, the Site Superintendent is generally responsible for documenting purchased goods and services on the Purchase Order, and in particular for:

- complete and accurate description or specification of the ordered product

  It's a constant fight to obtain reasonable technical data to back up a request for substitution.
- relevant technical information; including product performance parameters, quality and shipping/handling requirements

  The Submittal Review form located in the Forms section of this Protocol encompasses a submittal in support of a tender, and includes typical information valuable in assessing building envelope suitability. There is no reason a site superintendent should not assemble his/her own submittal data, which can be efficiently presented to the Building Envelope Reviewer in the event of a proposed "on the fly" substitution.

  A sample Purchase Order incorporating Quality management language is included in the Forms Section of this Protocol
- identification of the Supplier/Installer's Quality Management Representative.

3.1.3. Purchasing: Supplier Assessment

Perform the assessment of the Supplier/Installer suitability using the Builder personnel with the responsibility for procurement of required goods and services.

Make sure the folks buying the goods can work with the folks selling the goods.

Complete Supplier Assessment through an analysis of information regarding the Supplier/Installer profile including, where applicable, data regarding past performance.

Note: Whenever considered advantageous, the Builder may visit the Supplier/Installer's premises or other installations to verify the integrity of the received information.

True ISO 9001 certification would require some of the verifications to be in writing, e.g., proof of CSA certification.

Distribute a Supplier Assessment Questionnaire as follows:

- *to the new/potential Supplier/Installers prior to any formal commitment (submission of quotation or tender) to the Customer. An exception to this condition are the Suppliers and Installers generally considered suitable for business with the Builder. This "general suitability for business" status applies to the Supplier/Installer engaged by the Builder for the first time to perform minor construction or installation work or to provide a service*

which is not critical to the quality of the building envelope (i.e., equipment rental companies, catering, communication, etc.

- *to all approved Supplier/Installers who maintain ongoing continuity of business with the Builder every 3years.*

An Approved Suppliers List shall be maintained by the Builder personnel with responsibility for procurement.

Q-Tip-- **A List of Greatest Hits -** In our experience there is still reluctance by Suppliers and Installers to make any effort beyond predatory pricing to secure market share with Builders. Where we have a well developed relationship with a Builder, he/she may simply advise proponents of alternatives/ substitutions to give us the information we request to evaluate their proposals. We have started a list of pre-approved materials/systems, for which we keep necessary backup data. We neither solicit nor accept any remuneration for including a material/ system on our list. A reputable Builder will do the same, however there should be a cachet attached to being included on and remaining on a pre-approved list.

3.1.4. Purchasing: Data

Verify and endorse the adequacy of requirements related to the purchased goods and services by ensuring the Purchase Order contains, whenever applicable:

- *Precise identification of the product (name or description, type, grade, class, style, applicable standard, etc.)*
- *Clear reference to applicable drawings and specifications*
- *Required packaging, handling, storage and shipping instructions*
- *Other relevant information pertaining to quality of purchased goods and/or services*

The Submittal Review form located in the Forms section of this Protocol encompasses a submittal in support of a tender, and includes typical information valuable in assessing building envelope suitability.

3.1.5. Purchasing: Verification of Purchased Product

Evaluate the quality of purchased goods or services upon receipt of purchased goods or at any stage of delivery of subcontracted services, as considered practical. Verification methods employed by the Builder may vary depending on the importance of the purchased product, Supplier/Installer quality performance history and the adequacy of the quality system operated by the Supplier/Installer.

Whenever applicable, request a Certificate of Compliance, Guarantee or Warranty for goods and/or services which are considered critical to the quality of the finished wood frame building envelope. Critical goods or services are those which may jeopardize the quality, durability, reliability or safety of the finished building or otherwise seriously affect customer satisfaction. Purchased goods or services which may affect compliance required by appropriate regulations shall <u>always</u> be considered critical.

Whenever specifically agreed the Builder shall make appropriate arrangement with the Supplier to allow for inspection of the purchased goods at the Supplier's facility prior to delivery to the building site. This verification may be performed by the Builder or by the Customer Quality Management Representative and shall not absolve the Supplier/Installer from responsibility for the quality of purchased goods. Disregarding the circumstances of verification of purchased goods or services, the Builder shall also reserve the right to reject non-conforming product or to refuse to accept substandard services.

3.1.6. Purchasing: Records

Maintain the following records, either manual or electronic:

Item	Name	Responsibility
1./	Purchase Orders	Site Superintendent or other personnel nominated by the Builder
2./	Certificates of Conformance	Quality Management Representative (QMR) / Site Superintendent
3./	Supplier Assessment Questionnaire	QMR or other personnel nominated by the Builder
4./	Approved Suppliers List	Site Superintendent or other personnel nominated by the Builder
5./	Supplier Files	Builder personnel with responsibility for procurement

3.2. Control of Customer-supplied Product

3.2.1. Control of Customer-supplied Product: Definition and Purpose

Customer-supplied product is a product owned by the Customer and supplied under contractual agreement for incorporation in the building envelope by the Builder.

3.2.2. Customer-supplied Product: Guidelines

For simplicity and uniformity of the Quality System, the Building Envelope Provider should elect that, unless specifically requested and agreed otherwise, there will be no distinction between Customer-supplied products or products acquired otherwise by the Builder.

It should therefore be a policy of the Building Envelope Provider that for **all** received products, regardless of their origin or commercial arrangements, the Building Envelope Provider shall take appropriate steps to assure itself and its Customer that the received product is suitable for its purpose, and its condition and quality is verified and maintained. This policy applies to all goods and services provided by the Customer for incorporation in the finished building envelope.

Customer-supplied product shall be, therefore:

- *inspected upon receipt or at service completion stage.*
- *stored and/or maintained in a way which preserves quality of the supplied material or protects acceptable status of delivered services*
- *reported to the Customer if it is considered substandard or if supplied product is lost, damaged or found otherwise unsuitable for use.*

Results of these activities shall be documented

Verification of quality and quality for all products supplied to the Building Envelope Provider, including Customer-supplied goods and services, shall follow the guidelines of all related procedures documented in this Manual.

Applicable Sections of Quality Manual:

Contract Review
Purchasing
Product Identification and Traceability
Inspection and Testing
Inspection and Test Status
Control of Non-conforming Product
Corrective/Preventive Action
Handling, Storage, Packaging, Preservation and Shipping
Control of Quality Records

3.2.3. Customer-supplied Product: Records

Maintain relevant records, as indicated in the above procedures.

3.3. Product Identification and Traceability

3.3.1. Product Identification and Traceability: Purpose

The purpose of this procedure is to describe methods selected by the Building Envelope Provider to identify and trace components of the building envelope.This procedure applies to the completed building envelope and its individual components and to all stages of building envelope construction, assembly and assessment by the Building Envelope Reviewer. Whenever specified in contractual agreements, identification and traceability requirements may extend to the warranty provided for the building envelope by the Building Envelope Provider.

Whenever applicable, building envelope components shall be identified, including procured materials and services, sub-contracted work, design development stages, building envelope construction and verification, commissioning, and all other related activities defined in the contracted project scope.

A surprising number of materials are still delivered to construction sites without any identification, or with questionable identification. What is that black clad insulation, anyway?

We give preference to materials which are well labelled and come with application/ installation instructions.

This identification shall be maintained by the Building Envelope Provider in order to:

- *allow for proper monitoring of building progress*

- *ensure traceability of related work, purchased goods, equipment and services*
- *ensure adequate control of quality and quality-related activities*

Whenever contractually agreed, specific customer requirements regarding project identification, traceability of performed work and delivered services are to be accommodated.

3.3.2. Product Identification and Traceability: Responsibility

The Site Superintendent is responsible for coordination and progress of construction work and shall set up the guidance for building envelope identification and traceability. The Site Superintendent shall ensure these guidelines are followed.

All Building Envelope Provider personnel (within respective areas of responsibility and authority) are responsible to ensure compliance with building envelope identification and traceability guidelines as specified in this Manual and applicable instructions.

3.3.3. Product Identification and Traceability: Guidelines

The Building Envelope Provider shall ensure that building envelope identification and traceability methods:

- *reflect guidelines (if any) provided in project-related documentation*
- *ensure positive identification and traceability of building envelope components*

This means labels which remain visible throughout the construction process.

- *quote Project Number or other agreed identification on related documents, i.e. Purchase Orders, certificates, Invoices, check sheets, progress reports, submittals, etc.*
- *provide easy access to identification marking*
- *maintain legibility over required period of time (taking under consideration wear, deterioration, environment, etc.)*

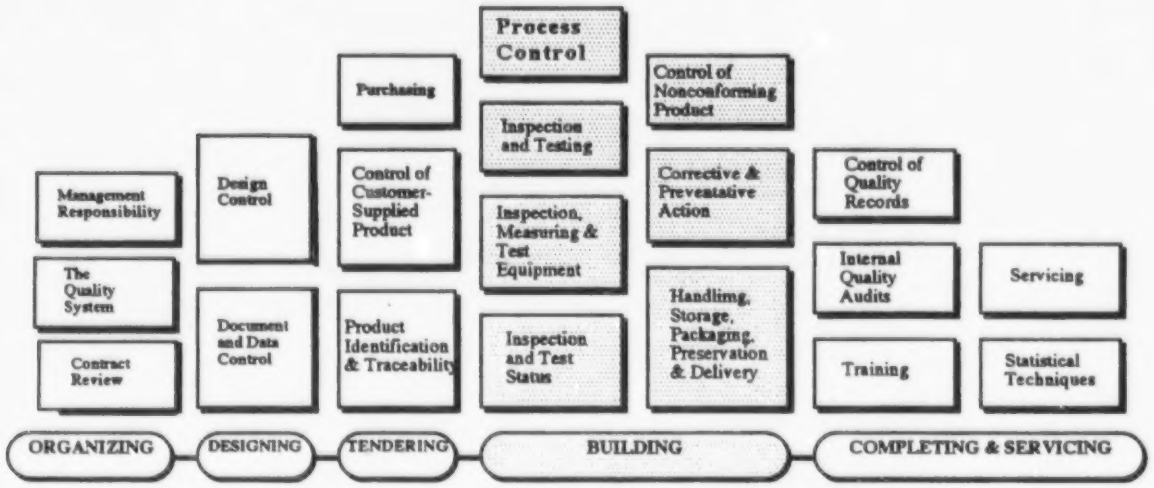
Methods of building envelope components identification shall suit Customer requirements, address specific needs of the building site, including building site logistics, environment and specific building construction concerns.

In other words, ask the personnel on site how they want product labelled for their eas of use.

3.3.4. Product Identification and Traceability: Records

Building site documentation and records shall be maintained and the identification with Project Number shall reflect established relationships between the Project, its individual stages and related documentation of the building envelope.

Chapter 4 BUILDING QUALITY



THE QUALITY ASSURANCE PYRAMID

4.0. Introduction

Not surprisingly, this chapter on Building Quality is the largest of the five. After all, all the other aspects of *Quality by Design* are meaningless if it can't be built right!

Control of the building envelope construction process should ensure that related operations proceed under controlled conditions, in an appropriate manner and sequence. Controlled conditions include appropriate controls for materials, construction equipment, personnel, supplies, utilities and environments. This rather complex requirement means that:

- quality of materials used for construction is verified and conforms to specified requirements
- construction equipment is in good working order and performs up to the Contractor's expectations
- personnel employed for building envelope construction are adequately trained and/or experienced
- required supplies are delivered on time, in requested quantity and in good condition
- operations are performed in line with applicable work instructions, trade practices and regulations
- construction work is only conducted in suitable environmental conditions

The ISO Standard sets out 7 sections which naturally fall under the building umbrella:

Process Control

- Building envelope Process Control means **"building the building envelope."** It encompasses the control of all activities, operations and processes necessary to erect the building envelope. The Building Envelope is defined as **"the horizontal, vertical and inclined assemblies which intercede between the interior and external environments"**. For simplicity and for the sole purpose of this Quality Manual, any combination of the above operations and processes we will call "construction" or "construction process". For the same reason we will also refer to the applicable activities, operations and processes as "operations".

Inspection and Testing

Inspection and testing at the building site cover three areas that have a direct influence on the quality of the finished building, its overall quality, proper functioning and expected durability.

These areas are:

a) Receiving Inspection which applies to the quality of purchased goods and services, including circumstances when goods or services are arranged and supplied to the site directly by the customer.

b) In-process Inspection which applies to the work performed on site by the Builder, Suppliers and/or Installers

c) Final Inspection is applicable to the finished product, or a defined part thereof, i.e. to a specific stage of the project such as concrete work, electrical, framing, cladding, etc.

NOTE: The word inspection, where used in this Section, may be taken to mean "review".

Inspection, Measuring and Test Equipment

A structural engineer who has recently become ISO 9001 certified confided in me that his ISO "coach" at one point suggested this meant he should calibrate his office's tape measures. The Engineer pointed out that whether a rebar is 18" or 19" long is seldom a matter for quality concern, and the requirement was quietly deleted.

Nonetheless, there is equipment used in determining building envelope adequacy which requires calibration. This Manual recommends calibration by third party specialists.

Inspection and Test Status

The status of inspections of a completed building envelope, building envelope components and or related purchased products should be identified at all stages of construction or storage of the components on building site.

Control of Nonconforming Product

The Builder is expected to establish and maintain an effective, documented system for control of nonconforming building envelope.

Procedures should exist for dealing with any non-conforming building envelope, however and whenever identified. The procedures should cover segregation and identification as well as policies regarding rework or acceptance under concession / deviation.

Corrective and Preventative Action

Corrective action is a problem which already has occurred and an immediate remedy is required.

Preventative action is taken in order to prevent future recurrence of a problem .

Handling, storage, packaging, preservation and delivery

The Builder is expected to establish and maintain procedures for handling, storage, packaging and delivery. The intention is to ensure that product is transported, stored, packed, preserved and delivered in such a manner that its quality is protected against possible damage or deterioration..

Q-Tips - Suggestions, tricks, and experiences which may assist in the application of the Quality Assurance Protocol are inserted where appropriate in this Section in the form of *Q-Tips* - comments enclosed in boxes like this one.

4.1. Process Control

4.1.1 General

The purpose of Process Control is to identify and implement methods of controlling the operations involved in building envelope construction. This requirement applies to all activities which directly affect the quality of work supervised and/or performed by the Building Envelope Provider.

4.1.2 Definitions

NOTE: Throughout this particular Chapter of the Manual:

Building Envelope means the horizontal, vertical and inclined assemblies which intercede between the interior and external environments

Building envelope construction means activities, operations and processes involved in erecting of the Building Envelope, and including necessary installations, insulation, cladding and finishing, as applicable.

Construction Work Log Book means the form of diary or similar record kept by the Site Superintendent.

Process means any operation that is conducted according to defined parameters.

Process control means activities involved in monitoring of the construction process aiming at continual determination of building envelope quality

Water management strategy means the combination of design and construction measures which controls the various forms of water which attempt to breach a building envelope.

Work Instructions mean directions, whether oral or written, which are in excess of standard construction practice. In the case of the Building Envelope, these would typically be directives specifically addressing envelope concerns.

4.1.3 Responsibility

QMR Responsibilities

- The Building Envelope Provider's Quality Management Representative (QMR) is responsible for providing requirements and guidance for building envelope construction controls and for workmanship acceptance criteria.

Building Envelope Reviewer Responsibility

- Where these vary or appear to vary from the standards inherent in design documents or existing codes, standards and trade practices, the QMR submits the variance information to the Building Envelope Reviewer for review and acceptance.

  Use the Submittal Review form in the Forms section of the Protocol as one means of identifying varying information.

Site Superintendent Responsibilities

- The Site Superintendent controls operations which may directly affect the outcome of building envelope construction process performed by the Contractor, and maintains a record of these activities in a Construction Work Log Book.

4.1.4 Process Control Procedures

Q-Tips - **A Simple Approach to Organizing** - Although 10 categories may seem 9 to many for some, we have used the following information management system on our projects for many years, with excellent results.

There are so many potential Process Control procedures that, in this Manual, only a few have been highlighted. It is expected that during the Review phase of this Draft, many procedures will be added by reviewers. It is further expected that each subscriber to the Quality Assurance Protocol will amend these recommendations to suit the particular aspects of their role and business.

In our professional practice as Architects, building scientists and Certified Professionals, we have found it convenient to divide projects into ten phases. For convenience, and as an organizing device as good as any other, we have organized Process Control Procedures within those same ten phases.

As these are procedures, i.e., directives, they have been written in the active imperative voice, much like specifications.

1 General/ Administration

a) At every step in the process, think of means to transfer the project's water management strategy into the completed building envelope.

This is where the concept, "Think like a raindrop" comes into play.

Q-Tips - **Charting the Path of a Raindrop** - We are aware of one Builder/Developer whose Consultants' required drawings include diagrams showing the drainage paths from every horizontal and inclined surface on the project, right down to the foundation drainage and sewer connections. In the same way that slab profile drawings have become commonplace in the past few years, perhaps drainage diagrams will follow.

b) Maintain Process Control activities according to the applicable Best Practices that provide guidelines for building envelope construction.

Either use the "Best Practice Guide" or develop your own as a valid, formal alternative.

Q-Tips - **Your Own Best Practice Guide** - No two individuals in the design and construction fields will agree on the best way to design something. Architects cannot be expected to adopt someone else's design "whole cloth", even without considering copyright issues. And builders cannot be expected to abandon their preferred materials, subcontractors and suppliers. The CMHC Best Practices Guide provides a vehicle for evolving one's own Best Practices in a professional and defensible fashion. The BPG details have a well developed theoretical basis. Where a Designer or Builder has an alternative approach to achieving an equal or better result, the reasons for variance can be described in relation to the BPG details, so that either the "better mousetrap" may be challenged, or integrated into a specific project.

c) Use Work Instructions to define methods of control only in such cases where the absence of guidelines could have negative affect on the quality of the building envelope.

Avoid meaningless statements such as "Use best workmanship..." Either specify what's expected, or accept the current standard.

Q-Tips - **Prescribing Construction Sequence is a Tricky Business** - The architectural and engineering professions have always been somewhat unhappy about defining sequences of construction operations. The concern is they may be seen to be doing the Contractor's job, thence become liable for resulting problems. However, there is nothing wrong with suggesting sequencing on drawings or in the field through the Contractor's site personnel. Brainstorming and trying new ways to deal with new construction methods are perfectly acceptable, provided Contractor personnel are present and issue any eventual instructions.

d) Document Work Instructions and relate them to customer requirements.

Q-Tips - **Capturing the Customer's Ideal Project Elements** - In our design work we draw out from Clients their Ideal Design Elements (IDE's) of a project - the idealized outcome of our efforts, in their own words. Like any essay or like this Protocol, these elements may be grouped under appropriate headings. For most projects, a Customer's Ideal Project Elements (IPE's) may be similarly captured. As building scientists, we identify the Customer's IPE's as related to longevity, maintenance strategy, tenure, etc. right at the contract stage. Any Building Envelope Provider should be able to similarly identify their Customer's IPE's, capture them on items like purchase orders and work instructions and thereby validate customer requirements throughout a project. If an instruction seems contrary to the Customer's IPE's, simply identifying the conflict will often lead to revision of the instruction (when the conflict is identified) or refinement of the IPE's. Either way, the Provider may proceed with clarity and a confirmed set of instructions.

e) Where applicable, use Work Instructions to define the specific activities involved in building envelope construction and methods of monitoring project progress.

f) Base Construction control processes on documented building envelope acceptance criteria.

Q-Tips - **Is your Building "To Code"** - Probably not! Building codes are the usual minimum acceptance criteria for construction. However, they are not perfect and contain internal contradictions, such as the requirement to simultaneously fire rate the underside of a balcony and vent it. In the building envelope arena, Part 5 of all of the National, Provincial and local (Vancouver) codes calls for some performance criteria which are impossible to meet at any construction standard below an engineered curtain wall. So, most building authorities do not enforce some aspects of the codes. Clients should be clear about which aspects of codes are not met, so that they may either a) upgrade construction quality or materials, or b) knowingly ignore codes in some areas (All lawyers reading this Protocol take note!)

g) Maintain Building envelope construction process records in a Construction Work Log Book.

All procedures should ideally be logged.

h) Include receiving, in-process and final inspection records as part of the evidence of the building envelope construction control.

i) Analyze the project delivery model proposed for the project as to impacts on building envelope construction

For example, a construction management project with phased "packages" of tenders will need to pay more attention to envelope construction sequencing than perhaps the traditional stipulated sum approach.

j) Try to combine related trade contracts into a single contract to reduce coordination problems and concentrate responsibility.

For example, some subcontractors who used install stucco only now handle substrate building papers, self-adhering membranes, etc.

k) Prepare, update and distribute a directory of all Quality Management Representatives (QMR's) associated with the project, in addition to any other directories.

l) Consider each communication required to achieve the above as a "template", reusable in future similar circumstances.

About 90% of our building science activities are documented on templates which have been customized for each job and occurrence, in a fraction of the time required to invent them from scratch..

2 Planning

a) Plan construction activities in logical sequences to minimize rework and/or damage to completed installations by succeeding operations

This seems self-evident, but continues to occur. Within a structure, it can lead to compromised fire safety, acoustics, etc. In the building envelope, it may lead to failure.

b) In designing structures, evaluate design concepts in relation to planning authority regulations which impact on building envelopes, such as roof overhangs.

A requirement to have, or not have, a roof overhang should probably drive the selection of wall materials, for example.

Q-Tips - **Formal Evaluation of Building Envelope Concepts** - We have incorporated elements of the Best Practices Guide, as well as other knowledge and experience, into our formal reviews of our own and others' designs. Included in those reviews are the Building Envelope Survey's findings about roof overhang vs. likelihood of problems, plus the relationship of weather exposure to envelope concept. If this type of analysis were undertaken at the outset of a design, we have no doubt some designs would evolve differently - not badly, just differently.

3 Design

a) Label or key on design drawings those elements which are critical to the successful performance of the building envelope

A related practice involves specifying materials whose finish characteristics are such as to make their place in the envelope self-evident. For example, the bright yellow of Dens-Glas®, the electric blue of Bakor Blue Skin®, the labeled white of Tyvek®, the bright colouration of various fire stop compounds, etc. These kinds of products make on-site review and instruction simpler, e.g., "If I can see the yellow Dens-Glas, something's missing."

b) Develop drawings, especially details, in a format which facilitates use on-site.

Many drawing sets never leave the construction office, partly because of the impracticality of their size. Smaller detail formats such as 8-1/2x11 or smaller facilitate use on-site. An on site copier also helps, allowing volume dissemination without concern for losing originals.

Seriously consider including the building science background information with details.

c) Provide opportunities for design feedback on drawings

For example, issue details as double sided, with one side containing the detail and the other containing space for logging installer comments and suggestions.

4 Permitting

a) Tell the water management "story" in the drawings and documents submitted for building permission.

A plan checker, whether internal to the Designer or with a Regulatory Agency, will be better able to review building envelope information where the water management strategy has been clearly explained.

In Vancouver, the energy utilization "story" also needs to be told at this time in the process.

5 Tendering

a) Communicate requests for alternatives or substitutions to the Building Envelope Reviewer, with sufficient information to allow for evaluation.

A Submittal Review form is included in the Forms section of this Protocol.

b) When evaluating tenders, especially alternate prices, factor in the maintenance/ call back costs over the extended warranty period.

6 Construction

a) Establish building envelope requirements at the initial site meeting, and review the Project's water management strategy on this occasion.

A sample building envelope design review meeting agenda is included with the Protocol.

b) Use construction mock-up's to address sequencing issues in advance of full supplies arriving.

It is important to construct mock-up's as early and as completely as possible, not just a week or so ahead of schedule trades start. Frequently, specified products do not work together, and the mock-up provides the opportunity to address these issues before quantities of material have arrived.

Q-Tip - **Never Enough Mock-ups** - Construction documents should specify a min imum set of mock-up requirements. You can't just spring this requirement as a freebee. However, in our experience, once Contractors understand that they can also use mock-up's to propose an alternative to specified construction (a "better mousetrap"?), they will experiment and seek Designer approval for the variations. On a current project, the "Peel & Stick" Contractor proposed an alternative procedure which improved the quality of window sill gussets while saving him significant time - a classic win-win.

c) Explain at the first site meeting or sooner the roles of the various parties having input/ responsibility/ authority/ liability for the building envelope, and the resulting requirements for communication.

7 Changes

a) Maintain a list of changes and log the progress of those changes

Refer to the Forms section of this Protocol for a Document Log format suitable for this purpose.

b) Add to specifications for "cutting and patching" consideration for the building envelope, both as to types of cutting requiring pre-approval, and specific patching instructions designed to preserve the building envelope integrity.

c) Copy the Building Envelope Reviewer (BER) with all Change correspondence.

A Building Envelope Reviewer might not wish to log all changes in a formal fashion, however it is dangerous to limit exposure to changes. Often the Reviewer will see significance in a proposed change which others thought was of no envelope consequence. The Reviewer should do the editing for relevancy, not others.

This need not require the BER to be yet another link in the process of change approval. Simply require the BER to react to proposed changes within a reasonable specified time frame.

d) Copy the Quality Management Representative (QMR) of the companies affected by changes with proposed change information.

As with the BER, they will react to change issues if given a reasonable time frame which parallels formal change approval.

This dissemination of information is particularly important with Site Instructions, which are often implemented immediately after issuance, because no contract change is anticipated.

e) Copy the Building Envelope Reviewer with any amendments to permits.

Often, exterior materials or forms are a result of permit amendments. These may have a major impact on building envelope design and construction.

8 Submittals

a) Prepare a list of submittals which the Building Envelope Reviewer needs to review, and log the progress of those submittals.

Refer to the Forms section of this Protocol for a Document Log format suitable for this purpose.

This log should be customized for each project.

b) Require shop drawing submittals to include information regarding surrounding conditions and how the shop drawn materials fit within the building envelope

This is a major struggle, as the construction industry continues to think about products as discrete items, with connections to the envelope "by others."

c) Require engineered shop drawings to be sealed at the first submission, as evidence that the designer has reviewed substrate and site conditions and incorporated same in designs

Another major struggle. Try rejecting a few submittals simply on the basis of an absence of appropriate pre-review evidence (i.e., seals). You may lose a few clients, but you will not lose any sleep (We have yet to lose a client on account of this approach).

9 Field Review

a) Prepare a detailed list of required Building Envelope Reviewer field reviews, and maintain it in a visible location on site as a Log of BER status.

This can also be a useful index or Log of field review activities.

The concept of a minimum list of required field reviews makes some professionals nervous, however we have no better solution at this time. Builders use the list as a checklist and reminder of what needs to be reviewed before the next construction phase begins.

b) Copy field review reports to all QMR's whose companies are affected by the field reviews.

Field review reports should note what's being done right as well as what's not. Communicating the good to QMR's reinforces the success of Quality Assurance as well as highlighting what works - positive reinforcement.

c) Prepare a list of required field samples (concrete tests, mortar samples, etc., and copy the BER and affected QMR's with test results.

d) Maintain an ongoing "punch"/deficiency list and update it at each field review. The increasing quantity of field reviews occasioned by more focus on the building envelope makes it easy to forget to revisit previously noted envelope deficiencies.

10 Completion

a) Prepare a list of information requirements for occupancy, both regulatory requirements and warranty/ maintenance requirements.

b) Throughout the Project, collect building envelope maintenance information, including shop drawings, samples, manufacturers' literature (especially maintenance instructions)

c) As each trade's work is completed, organize a pre-occupancy review with the Building Envelope Reviewer and the appropriate QMR's, to review the completed work as to deficiencies, etc.

4.1.5 Process Control: Records

The following records shall be maintained by the Contractor in regard to the building envelope construction process activities.

Item	Name	Responsibility
1./	**Work Instructions**	Site Superintendent/ Quality Management Representative, as applicable
2/	**Construction Work Log Book**	Site Superintendent
3./	**Review & Inspection records**	Site Superintendent / Quality Representative, as applicable

4.2. Inspection and Testing

4.2.1 Inspection and Testing: General

Inspection and testing at the building site cover three areas that have a direct influence on the quality of the finished building, its overall quality, proper functioning and expected durability.

These areas are:

4.2.1.1. Receiving Inspection which reviews the quality of materials received on site, including materials supplied by the Customer.

4.2.1.2. In-process Inspection which covers the work performed on site by the Builder, Suppliers and/or Installers

4.2.1.3. Final Inspection which reviews the finished product, or a defined part thereof, i.e. to a specific stage of the project such as concrete work, electrical, framing, cladding, etc.

The definitions contained in this Section of the Quality Manual address basic requirements constituting the very foundation of the Contractor quality system.

NOTE: The word inspection, where used in this Section, may be taken to mean "review".

4.3. Receiving Inspection And Testing

4.3.1 Receiving Inspection and Testing: Introduction

Whenever goods are purchased from a Supplier or the specific services of a Sub-contractor or Installer are ordered, the quality of the received products or the services outcome should be verified. This Section of the Manual addresses the means of verifying those outcomes.

A **Receiving Log** is used to record the quality of incoming products and services.

These actions help assure the quality of procured goods and services and assist in proper inventory control at the building site. Early identification of nonconforming goods or services enable their prompt return or rework before any substandard product is used by the Contractor. A well maintained Receiving Log (or any other document of similar nature) provides documented evidence of product and service quality. This evidence may be invaluable when it is required by an insurance company or for legal purposes (i.e. when product was damaged during handling or transportation or in case of dispute between the Contractor and the Supplier or Sub-contractor). In some cases receiving Inspection of specific products may be required to comply with regulations or industrial codes. The quality of goods and/or services arranged by the customer for incorporation in the final product should be verified.

For practical reasons documentation of these activities is kept to a necessary minimum.

4.3.2 Receiving Inspection: Responsibility

The Quality Management Representative or designate is responsible for the Receiving Inspection activities.

The "designate" is usually a site superintendent or onsite Project Manager.

The Site Superintendent is responsible for basic Receiving Inspection. Unless specifically decided otherwise, the Receiving Inspection activities focus on general compliance of the purchased goods with contents of the Purchase Order issued by the Builder (verification of Purchase Order Number, received parts Part Number and quantity). As a part of the Receiving Inspection activities the overall condition of the purchased product shall also be assessed, looking for evidence of handling damage or symptoms of deteriorating quality of the incoming goods.

Special handling requirements shall be identified at this point, for consideration under Section 4.10 of this Chapter.

4.3.3 Receiving Inspection: "Critical" Product

The Quality Management Representative in conjunction with the Builder's management shall identify all "critical" product purchased by The Builder.[1]

For years we have been identifying "long lead" items for special attention. We now need a new class of long lead items - those for mock-up construction.

"Critical" product is defined as a product having a direct and significant influence on the quality of the exterior of multi-storey wood frame buildings. This relates in particular to nonconformance of the purchased goods or services which may cause customer complaints or significantly reduce expected building envelope durability.

For example, glazing/curtain wall systems, EIFS, etc.

4.3.4 Receiving Inspection: Inspection Level

The amount and nature of Receiving Inspection shall be reflected in frequency of inspection and inspection criteria.

Unless specified otherwise, the following principles shall apply:

1.) Receiving inspection shall always be performed when:

- there is an obvious damage to the product in "as supplied" condition
- the supplied product is classified as "critical"
- the quality of the product purchased from a given source was previously found to be non-conforming to the Builder requirements. Subsequent deliveries of the subject product from the same source shall be verified, until such time as confidence in the Supplier's performance has been re-established.

2.) **Basic Receiving Inspection** shall be performed for all purchased product, unless advised otherwise. Basic Receiving Inspection shall embrace:
- identification of the purchased product against shipping and order documents
- confirmation of the quantity of the received goods
- visual inspection looking for obvious evidence of transport/handling damage, if any.

4.3.5 Receiving Inspection: Procedure

General requirements:

a.) Whenever practical or required by relevant regulations, a Certificate(s) of Conformance shall be requested for all purchased product classified as "critical".

b.) The Receiving Inspection Log shall be maintained

c.) Product shall either be labeled so that a Reviewer can ascertain when the product is in place that it is correct, or, where product labeling is deficient in place, bundle labels, packaging, etc., shall be kept to identify the product, and the evidence shall be labeled with the location(s) it was installed in.

We have a stated preference for materials which are self-labeled, and we make no bones to suppliers that they should label materials if they seek our approval for their use on our projects.

The following procedure applies to the Receiving Inspection of the purchased product:

a.) The Builder personnel involved in purchasing shall:
- provide the Quality Management Representative with information pertaining to the quality of the purchased product
- communicate to the Suppliers all information regarding the quality requirements of the purchased product

(If there's a problem, don't keep it a secret)

b.) The Quality Management Representative or nominated designate shall perform Receiving Inspection.

c.) A "HOLD" Tag shall be issued for product which are found to be nonconforming.

d.) The Quality Management Representative or Site Superintendent shall advise the Builder's purchasing personnel as to the disposition of the nonconforming product

4.3.6 Receiving Inspection: Records

The following records shall be maintained:

Item	Name	Responsibility
1./	"Critical" Product List	QMR

2./ Certificates of Conformance	Receiver / Site Superintendent
3./ Receiving Log	Receiver

4.4. In-Process Inspection and Testing

In-process Inspection applies to the work performed at the building site by the Builder or Installers.

The very nature of the building envelope makes it essential to verify the quality of workmanship and the quality of materials used in construction as soon as possible, at the interim stages of construction. Early correction of identified nonconformity helps eliminate cases of unsatisfactory building envelope quality, which might otherwise become obvious only at the later stages of project development. This approach is particularly effective when in-process inspection is performed at the end of each specific project development stage (i.e., at trades "hand-off", etc.), catching substandard workmanship or defective materials before their rectification becomes "uneconomical" or "impractical".

Evidence of acceptable quality may be of great importance where a customer questions the quality of the building. In-process Inspection at specific stages of building construction is also required to comply with building regulations and may constitute a pre-condition to an interim approval of the development by a building inspector.

Inspections are recorded using a **Field Review Report** which is designed where possible as a simple checksheet, which provides information pertinent not only to the matters related to quality but also suitable for overall monitoring of the work in progress.

Refer to the Appendix for some sample Field Review Reports

Q-Tips - **How to Evolve a Field Review Report (FRR)** - Many Designers/ Reviewers use a simple memo pad on which to record field review comments. This works well for "custom" or unique situations, but less so when the field review in question is repetitive as to content, for example, the insulation at each level of the building. With a bit of care, a base FRR document can be built up over time to incorporate an unlimited number of variations describing the repetitive but essential field reviews required for a building envelope. Appendix A includes a selection of Field Review Reports designed for manual fill-in and all derived from different layers of the same computer file.

Q-Tip - **FIRESTOPPING INSPECTIONS** - Many firestop products are now colour coded. However, the manufacturer's literature which describes in detail appropriate applications is too expansive to carry around on field reviews. When the firestop supplier sends through literature for review by the building envelope reviewer, the transmittal should indicate (via matrix, table, etc.) which product, including its colour, which applies to each type of penetration. This transmittal can be easily carried around by the building envelope reviewer and Builder, improving the chances of catching discrepancies and allowing easy selection of the right material where openings are found to be incomplete.

Q-Tip - **DIFFERENTIATING SIMILAR MATERIALS DURING INSPECTIONS** - Some envelope materials such as roofing membranes, waterproofing membranes, self-adhering membranes (i.e., peel & stick) may be on a site in a number of forms and products. Although submittals may have samples, the complexity of submittals makes them inappropriate to carry along on field reviews. However, small samples of the range of such materials can be adhered to a piece of cardboard or stiff paper and labeled as to name and approved uses. This sample card can be easily carried along on field reviews for instant checking where a particular installation is suspect or direction is requested as to the appropriate product for a particular condition.

Q-Tip - **PRE-AUTHORIZATION FIELD REVIEWS** - Building Envelope Reviewers are frequently requested to verify installations prior to succeeding activities starting which are dependent upon or will cover the areas to be reviewed. It is useful to have the foreman of the trade scheduled to proceed next attend these pre-authorization reviews. Although most specifications and purchase orders contain language which requires successive trades to accept the preceding work,, this acceptance review is often missed. Although the responsibility may clearly lie with the succeeding foreman, many debates about quality will be avoided if acceptance is confirmed through attendance at the pre-authorization review. One additional result is that the Building Envelope Reviewer can confirm the interface between successive trades.

4.4.1 In-process Inspection and Testing: Purpose

The purpose of this procedure is to define guidelines for in-process quality verification at the construction stage of the building.

In-process Inspection ensures that:

a) the constructed building conforms to the Product Specifications, Best Practices and/or Customer requirements;

b) a substandard, non-conforming building envelope or a part thereof is identified and held in abeyance until deficiencies are corrected;

c) the losses caused by the construction of nonconforming building envelopes are minimized through early detection of the non-conformity;

4.4.2 In-process Inspection and Testing: Responsibility and Procedure

The Building Site Superintendent , the Building Envelope Reviewer and the Builder's Quality Management Representative (QMR) are responsible for In-process Inspection. Among other things, this means:

a) The Site Superintendent advises the Building Envelope Reviewer (BER), with reasonable notice, when a BER field review is requested.

Note that it remains the BER's professional judgment as to whether and ultimately when field review is required.

b) The Site Superintendent or designate attends at all in-process field reviews and distributes reports thereof to those affected.

The Builder's Quality Management Representative (QMR) or designate performs a Patrol Inspection function and provides assistance to other Builder personnel during In-process Inspection on an "as required" basis.

The BER may not / should not issue an assurance regarding the building envelope until deficiencies identified during in-process field reviews have been rectified.

Authorized Builder personnel:

- perform in-process inspection activities;
- put "on hold" non-conforming elements of the wood frame building envelope;
- release conforming elements of the wood frame building envelope for the next construction stage, except where continued construction may be impacted by "on hold" areas;
- maintain adequate records of In-process Inspection and Testing

The responsible Quality Management Representative (QMR):

- inspects elements of the wood frame building envelope areas on "HOLD", whenever reasonably required as a result of the completion of repairs
- provides recommendations regarding rectification of nonconforming elements of the wood frame building envelope (in conjunction with authorized Builder personnel)

  It is important to note that Designers cannot direct the Builder or the Builder's work force to perform in certain ways. Hence the use of the term "recommendations."
- re-inspects or verifies re-inspection of the reworked / rectified areas.

4.4.3 In-process Inspection and Testing: Records

The following records shall be maintained:

Item	Name	Responsibility
1. /	"HOLD" Tag	QMR/Site Superintendent
2. /	"HOLD" Tag Log	QMR/Site Superintendent

Q-Tip - **Cold Weather Procedures** - Various materials, such as stucco, concrete and masonry, have restrictions on their application in low or high temperatures. The Builder should include a standard residential type outdoor thermometer on site, perhaps at the construction site office. Affix a plastic laminated card behind the thermometer indicating temperatures at which special measures "kick in", and label those temperatures on the card, calibrated to the particular thermometer. Summarize protection measures on cards or checklists and post these inside on the wall adjacent the thermometer, for quick reference.

4.5. Final Inspection And Testing

Final Inspection and Testing takes place when the whole building or a specific stage of the building construction is completed. For purposes of this Manual, Final Inspection and Testing is defined as an inspection of the completed wood frame building envelope performed by authorized Building Envelope Review personnel. These activities provide documented input to formal verification of building envelope quality acceptance. It has to be noted that the outcome of Final Inspection and Testing activities performed by the Building Envelope Reviewer is not a substitute, nor a determining factor which may influence results of formal assessment performed by regulatory authorities such as the building inspector.

The main purpose of Final Inspection of the wood frame building envelope is to enable the Building Envelope Reviewer to reconcile results of preceding inspection stages such as receiving and in-process inspection with the quality of the finished product. An additional outcome of Final Inspection and Test activities is an opportunity to verify the effectiveness of corrective actions (if any) in cases when substandard quality or other type of nonconformity have been identified at earlier stages of the project. Where applicable, an assessment of the overall quality of the finished wood frame building envelope should include verification of the records pertaining to the interim stages of construction.

Final Inspection results should be documented[2]. These records combined with the results of interim "per stage" inspection and testing provide vital insight into both the in-progress and final quality of the building envelope. Their existence may help in circumstances when the building envelope is blamed for warranty or post warranty problems and, in particular, when customers complain and action is required. Final Inspection may also be required to comply with building regulations and may necessitate formal endorsement by the Building Envelope Reviewer and/or municipal staff.[3].

As an alternative to checklist type final review documentation, traditional documents such as a Certificate of Substantial Performance and Letters of Assurance may be used.

4.5.1 Final Inspection and Testing: Purpose

- To define quality verification activities related to the Final Inspection and Testing of the wood frame building envelope.

Final Inspection and Test activities shall ensure that:

a) the quality of workmanship and the quality of materials used for the inspected wood frame building envelope is verified and conforms to the building specification and related regulatory requirements (if any).

b) inspection and test results, including those relevant to Final Inspection but completed at preceding stages have been verified.

c) all activities involved in Final Inspection and Testing are completed

d) the associated data and documentation are available and authorized.

e) only a finished wood frame building envelope or portion thereof of satisfactory quality is released for further stages of construction or occupancy.

4.5.2 Final Inspection and Testing: Responsibility and Procedure

The Site Superintendent and the Builder Quality Management Representative are jointly responsible to maintain control over and ensure compliance with all relevant procedures related to Final Inspection and Testing.

The Site Superintendent (s) and the Quality Management Representative, shall ensure that:

a) Final Inspection and Test activities are performed and documented, as defined in this Manual and relevant Standard Operating Procedures (Practices)

b) specified quality criteria are met

c) nonconforming elements of the wood frame building envelope (if any) are identified for resolution using the procedures of other sections of this Manual

d) adequate records of Final Inspection and Test are endorsed and maintained.

No wood frame building envelope shall be released for an inspection by a Building Envelope Reviewer until all Final Inspection and Test activities are completed and their results are found to conform to specification.

Authorized Building Envelope Review personnel shall:

a.) verify satisfactory completion and condition of the wood frame building envelope;

b.) identify nonconforming elements (if any) of the wood frame building envelope, as defined in Section 4.13 of this Manual

The "Summary of Project Deficiencies" form in Appendix A is one means to identify on an ongoing basis deficiencies and their resolution.

The Quality Representative or designate shall:

a.) ensure that documents related to the wood frame building envelope quality verification are available and/or provided when specifically requested by the customer.

b.) confirm interim (i.e. receiving, in-process) inspection results, where appropriate.

c) verify if rework / repair of nonconforming elements of the wood frame building envelope has been completed.

d) arrange for repeat of the wood frame building envelope inspection and testing whenever required

4.5.3 Final Inspection and Testing: Records

The following records shall be maintained:

Item Name	Responsibility
XXXXdocument	Building Site Manager / Quality Representative

4.6. Inspection, Measuring and Test Equipment

4.6.1 Inspection, Measuring And test Equipment: Introduction

Various of the Builders, Designers, Suppliers and Installers will already have a documented system to control, calibrate and maintain inspection, measuring and test equipment used for the purpose of verifying the conformance of elements of the building envelope to specified requirements.

A properly defined control system for inspection, measuring and test equipment ensures that:

- calibration status of measuring/test equipment is identified
- calibration of inspection, measuring and test equipment is maintained at defined intervals
- storage methods and environmental conditions protect the equipment against damage or deterioration
- equipment is properly selected and meets regulatory requirements
- when equipment is found to be out of calibration, quality verification results are re-confirmed
- calibration records are maintained and made available to the Customer upon request
- when selecting appropriate inspection, measuring and test equipment the Contractor shall make sure that chosen equipment will be suitable for this specific purpose.
- whenever equipment is equipped with software or use computer for data processing purposes, the requirements regarding its calibration extend also to related software and hardware.

It is strongly recommended that test equipment users employ independent, certified testing laboratories to provide calibration services on in-house equipment, at intervals defined by those independent companies in conformance with ISO 9001 standards.

4.6.2 Inspection Equipment: Responsibility

It is the responsibility of the Quality Management Representative to ensure compliance with all relevant procedures and standards related to inspection, measuring and test equipment control.

4.6.3 Inspection Equipment: Records

The following records, either manual or electronic, shall be maintained:

I	Document	Responsibility
1./	Inspection Equipment - Calibration Labels	Quality Assurance
2./	Inspection Equipment Calibration Records	Quality Assurance
3./	Inspection Equipment Log and Calibration Schedule	Quality Assurance

4.7. Inspection and Test Status

4.7.1 Inspection and Test Status: Introduction

The status of inspections of a completed building envelope, building envelope components and or related purchased products should be identified at all stages of construction or storage of the components on building site.

In the simplest sense, this confirmation is provided by the "Summary of Project Deficiencies" included in Appendix A. This may suffice for building envelopes.

ISO 9001: 1994 Standard requires that "*...the inspection and test status of product shall be identified by suitable means, which indicate the conformance or nonconformance of product with regard to inspection and tests performed...*".

Examples of such inspection status are "awaiting inspection", "accepted", "rejected", "suspect" and "waiting test". Whenever practical this identification can be by tag, prominently displayed bin card, tear-off batch card, appropriate description or other means. For traceability purposes selected methods and means of inspection status identification should also provide information regarding the authority which endorsed or issued related information, and ensure reference to the specific component of the building envelope, if required.

This is an interesting concept, given that building envelopes are seldom so labeled. The practicality and usefulness of this approach vs. traditional field reviews should be explored at the "test drive" stage of the QAP development.

4.7.2 Inspection Status Identification: Responsibility

It is the responsibility of the Quality Management Representative to maintain control over and ensure compliance with all relevant procedures related to the inspection and test status identification.

The Site Superintendent or designate is directly responsible for identification of the building envelope and its components inspection and test status. This requirement applies also to purchased products and subcontracted services.

4.7.3 Inspection Status Identification: Procedure

Inspection status shall be identified as follows:
(As an example procedure)...

I	Project Stage, Construction or Assembly Stage	Inspection and Test Status Identification Method	Associated Documents & Evidence	Comments
1	Purchased materials	Received material retained in "Receiving Zone" prior to inspection. "HOLD" tag for material awaiting inspection Authorized personnel initials shall be applied to HOLD Tag on all products released under concession. No identification for conforming material.	Initials of shipper/receiver on product delivery documents. Entry in Receiving Log.	
2	Pre-fabrication, Construction and/or Assembly	"HOLD" tag for material awaiting inspection (including concession, sorted or reworked material) "HOLD" written in red colour. Initials of person who issued "HOLD". No identification for conforming material.	Inspection Status identified on Check Sheets. Entry in "HOLD" Tag Log.	
3	Final Inspection and Test, Building Envelope Review, Commissioning	Building Inspector (Building Envelope Reviewer) Report. No identification for conforming material.	Final Inspection Check Sheet, Reviewer Report	

4.7.4 Inspection and Test Status: Records

The following records, either manual or electronic, shall be maintained:

I	Document	Responsibility
1./	"HOLD" Tag	Site Superintendent, Site Foremen, QM Representative
2./	"HOLD" Tag Log	Quality Management Representative
3./	Inspection Check Sheet	Site Foremen, Quality Management Representative
4./	Concession	Quality Management Representative
5./	Concession Log	Quality Management Representative

4.8. Control of Nonconforming Product

4.8.1 Control of Nonconforming Product: Introduction

The Builder is expected to establish and maintain an effective, documented system for control of nonconforming building envelope.

Procedures should exist for dealing with any non-conforming building envelope, however and whenever identified. The procedures should cover segregation and identification as well as policies regarding rework or acceptance under concession / deviation.

Key Concepts -

- the procedure should specify the authority and method for identification, evaluation, segregation and disposition
- repaired or reworked building envelope or purchased materials should be re-inspected
- concession/deviation for nonconforming building envelope should be issued by authorized personnel only. Customer acceptance should be sought, whenever nonconformance does not comply to agreed specification of contractual terms and conditions.
- purchased product which was found nonconforming is separated from acceptable products in quarantine/bond areas whenever practical.

4.8.2 Control of Non-conforming Product: Definition and Purpose

For purposes of this Quality Manual, non-conforming product is a building envelope, element of building envelope, purchased material or service that does not conform to specified requirements. This definition of nonconforming product extends to the building envelope, purchased product or subcontracted service of unknown or uncertain quality status, as applicable from building site management point of view..

The purpose of this procedure is to ensure:

a) control of the non-conforming product, at any time or at any stage of construction, installation, verification or commissioning

b) avoidance of non-conforming product unintentional or accidental use, processing or installation

c) steps necessary to control non-conforming product release under concession / deviation

d) proper identification, documentation, evaluation, segregation and disposition of nonconforming product

4.8.3 Control of Non-conforming Product: Responsibility

The Quality Management Representative maintains control over and ensures compliance with all relevant procedures related to the non-conforming product. The QMR is also responsible for making necessary arrangements

and review of the non-conforming building envelope and its proper disposition.

Builder's personnel are responsible for investigating reported deficiencies, which shall be reported on a Corrective Action Request or similar means.

4.8.4 Control of Non-conforming Product: Procedure

In order to maintain control of the non-conforming building envelope or elements thereof the recommended procedure is followed:

a) A "HOLD" Tag is made available to Builder's personnel, who are trained in its use.
Responsibility: Quality Management Representative, Site Superintendent and Site Foremen.

b) A quarantine area(s) is established for storage of non-conforming product.

c) Non-conforming product is identified using the "HOLD" tag and entered in a Hold Tag Log.
Responsibility: Site Superintendent

d) If non-conformities are visibly identifiable, a contrasting tape such as Tuck Tape is used to label them.
Best is a material you can write on.
Responsibility: Site Superintendent, Site Foremen, Quality Management Representative

e) Disposition of the non-conforming material/product is generally as follows:

i) Product okayed, tag removed, product returned, log noted accordingly;

ii) the material is deemed acceptable, but of different quality than specified, so a "CONCESSION" is obtained and so recorded.
Responsibility: Site Superintendent, Site Foremen, Quality Management Representative

iii) if decision is "REWORK" , reworked product is re-inspected after rework/repair is completed and approved, or cycle repeated.
Responsibility: Quality Management Representative

iv) if the decision is "REJECT": the "REJECT" disposition of the reject building envelope or its element (return, scrap, other) is indicated on the

"HOLD" Tag. Following final disposition of the rejected product the "HOLD" Tag is returned to the Quality Management Representative

v) Corrective Action Request shall be issued, whenever considered appropriate

Responsibility: Quality Assurance and/or authorized Builder's personnel

4.8.5 Control of Non-conforming Product: Records

The following records, either manual or electronic, shall be maintained:

I	Document	Responsibility
1./	"HOLD" Tag	Site Superintendent, Site Foremen, QM Representative
2./	"HOLD" Tag Log	Quality Management Representative
3./	Concession	Quality Management Representative
4./	Concession Log	Quality Management Representative

4.9. Corrective and Preventative Action

4.9.1 Corrective and Preventive Action: Introduction

Corrective action usually refers to a problem which already has occurred and when an immediate remedy is required in order to correct the existing situation.

Preventative action is usually taken in order to prevent future recurrence of a problem or in order to eliminate the possibility of the problem which was probably identified on the basis of analysis of available data, historical performance of similar designs, etc.

Properly structured quality problem reporting procedures follow the principles of Edward Deming's Plan-Do-Check-Act (PDCA) formulae, which are fundamental to an effective continuous improvement process. PDCA begins with detection and reporting of an experienced quality-related problem. The Quality report is subsequently investigated in a manner which ensures, whenever possible, proper identification of the true "root cause" of the problem. When the origin and nature of the problem are positively established, an appropriate corrective action is defined and implemented as soon as practical. The last step evaluates and confirms the effectiveness of corrective / preventative action. If corrective / preventative action is successful and reported problem is eliminated no further action is necessary. If, however, effects of implemented corrective / preventative actions are unsuccessful or only partially successful, the above cycle is repeated until satisfactory remedy is identified and implemented.

The responsibility for instituting corrective and/or preventative action should be allocated with a person within the Building Envelope Provider organization who possesses an adequate level of authority to stimulate effective countermeasures. The analysis of reported problems, identification of the "root cause", and execution of defined corrective / preventative action may involve various competent personnel.

In order to properly define the origin of the problem, the relationship of cause and effect should be determined whenever possible and/or practical, with all potential causes considered. Corrective action (repair, rework) may take place immediately after the problem is defined and disposition of the nonconforming product is made by authorized personnel of the Building Envelope Provider. On the other hand the determination of "root cause" is essential before the preventative measures are defined and implemented.

The verification of the corrective / preventative action effectiveness should be documented and may include immediate/interim and long-term/final analysis of implemented actions achieved through outcome monitoring. It is also strongly recommended that effectiveness of corrective / preventative action should be verified and confirmed by the originator of the original complaint or an authority representing interests of the affected party.

Q-Tips - **RECORDING QUALITY EXPERIENCE "ON THE JOB"** - Bad enough that many construction details are too large to accompany the worker to the corner/opening/service space where the detail is to be constructed - how to then encourage the recording of quality experience with that detail? One suggestion is as follows: 1) Place each envelope detail on the top 1/2 of a standard 8-1/2 x 11 sheet. Place applicable specifications, installation notes, etc. on the bottom half. On the reverse side, provide note space allowing for worker/foreman/site supt. comments as to installation experience - what works and what doesn't. Install a laminator in the construction office and laminate each detail sheet, fold it in half and issue the workers with felt pens to record their observations. Fold the details in half so they fit in a pocket or on a belt loop.. One site superintendent of our acquaintance issued "today's details" each morning from the site office, and collected them at day's end.

4.9.2 Corrective and Preventative Action: Quality Problem Definition

A Quality Problem is defined as:

a) substandard quality of the building envelope not conforming to the design specification or building envelope guidelines;

b) unsatisfactory (not conforming to specified requirements) performance of the Building Envelope Provider as seen from the project management perspective

4.9.3 Corrective and Preventative Action: Reporting

Problems related to the quality of the building envelope shall be reported on a Corrective Action Request form or similar. The CAR documents experienced problems and may be issued following a customer complaint, assessment of the building envelope by an authorized Building Envelope Reviewer or in any circumstances when the quality of building envelope or its part is questioned.

Note: Pertinent communication is attached whenever a CAR is issued.

The originator of a CAR shall ensure that the description of the reported quality problem contains all necessary information allowing for its further meaningful investigation.

The following information must be provided, where applicable:

a) description of the problem/discrepancy
b) affected area identification (location of nonconformity)
c) definition of extent of the reported problem
d) CAR issue date
e) name of the originator

A CAR is recorded in the Corrective Action Request Log (CAR Log) maintained by the Building Envelope Provider's Quality Management Representative.

4.9.4 Corrective and Preventative Action: Investigation

Investigation of the reported problem is conducted within an indicated time frame (if any) related to the impacts of the problem. Reported problems shall be verified (if necessary) with the originator, and investigation shall aim at identification of the "root cause" of the problem, whenever possible.

In order to instigate corrective and/or preventative action(s), the Building Envelope Provider's Quality Management Representative (and personnel of other departments, as directed) shall also investigate historical data, customer complaints and other quality records to detect and analyze potential causes of non conformance.

Investigation results shall be documented on the CAR.

4.9.5 Corrective and Preventative Action: Implementation

The outcome of a CAR investigation is reviewed by authorized Building Envelope Provider's Quality Management Representative who shall endorse proposed corrective and preventative action(s) including suggested implementation time frame.

A request for corrective/preventative action may include modification of documented procedures, existing legislation or guidelines, whenever applicable.

4.9.6 Corrective and Preventative Action: Confirmation

The Building Envelope Provider management shall take steps to ensure that corrective/preventative actions are implemented effectively and within established time frames. Effectiveness of the corrective/preventative action is confirmed and documented on the Corrective Action Request form. CAR is re-instated when corrective/preventative action was found ineffective and further investigation is required.

The Building Envelope Provider's Quality Management Representative is responsible for communicating results of the implemented corrective and/or preventative actions to the Building Envelope Provider management.

4.9.7 Corrective and Preventative Action: Records

The following records shall be maintained:

Item	Name	Responsibility
1./	Corrective Action Request (CAR)	Quality Management Representative
2./	CAR Log	Site Manager

4.10. Handling, Storage, Packaging, Preservation and Delivery

4.10.1 Handling, Storage, Packaging, Preservation and Delivery: Introduction

The Builder is expected to establish and maintain documented procedures for handling, storage, packaging and delivery. The intention of these procedures is to ensure that product is transported, stored, packed, preserved and delivered in such a manner that its quality is protected against possible damage or deterioration..

This requirement applies to all products, i.e., building materials, purchased and customer-supplied building envelope components, components of the building envelope at interim stages of construction process, and the finished building envelope when ready for inspection by the Building Envelope Reviewer.

Evidence of compliance with the above requirements may be demonstrated in the form of:

- defined methods and means of handling to prevent damage or deterioration
- maintained secured storage areas
- records reflecting receipt and dispatch of building envelope materials and components by authorized personnel
- identification, preservation and segregation of building envelope materials and components

General requirements regarding packaging do not apply to the building frame envelope except for:

- identification of building envelope materials and/or components
- packaging requirements which constitute part of building envelope materials and/or components preservation requirements

A building site maintained in line with above requirements ensures that:

- building envelope materials and/or components are protected against deterioration at all stages of construction
- the condition of building envelope materials and/or components may be periodically assessed
- building envelope materials and/or components stock rotation should be maintained, where applicable
- building envelope materials and/or components packaging and preservation methods should conform to contractual agreements and provide proper protection against damage and/or environmental conditions
- building envelope materials and/or components handling instructions will be followed
- preparation of the building envelope materials and/or components for inspection is completed

4.10.2 Responsibility

Responsibility for protection of the product against damage or deterioration rests with all personnel of the Builder involved in project management and building envelope construction activities.

The Site Superintendent and Builder's Quality Management Representative (QMR) are directly responsible for compliance with practices related to the building frame materials and/or components handling, storage, packaging, preservation and delivery.

4.10.3 Handling[4]

Handling of building envelope materials and/or components is performed in such a way that quality is protected against damage and deterioration at all stages of building envelope construction, from the receipt of building and installation materials to commissioning. This includes product protection during loading, unloading, and transportation of any kind at the building site.

The Contractor shall comply with guidelines provided in this Quality Manual, related procedures, and instructions or warnings required by applicable regulations. Handling requirements and standards shall be considered in conjunction with operators training, including forklift / crane operators training, and applicable regulations.

The methods of handling applicable to building envelope materials and/or components should provide for correct use of handling equipment and accessories to prevent damage due to excessive stresses, vibration, shock, abrasion, corrosion, environment or any other conditions occurring during handling. These requirements shall specifically address correct use of handling means available at the building site such as trucks, conveyors, cranes, forklifts, elevators, etc.

4.10.4 Storage

Building envelope materials and/or components shall be stored in designated storage areas, in a manner that ensures:

a) no product damage or deterioration may occur due to the storage / environmental conditions

b) condition of the stored product is assessed periodically

c) receipt and dispatch of building envelope materials and/or components is authorized and documented

A documented system for the receipt of incoming building envelope materials and/or components is established, put into use and maintained. See also Receiving Inspection, Section 4.10.2 of this Manual.

Appropriate storage methods suitable for conditions applicable to specific building site should be specified to avoid deterioration of building envelope materials and/or components. Storage conditions and the condition of product in stock

should be checked periodically to detect as early as possible any symptoms of product loss, damage or deterioration.

Items with limited shelf life or requiring special protection during storage should be identified. This requirement applies in particular to all building envelope materials and/or components with limited shelf life such as paints, resins, glues, sealants, fillers, etc. stock rotation based on first-in-first-our principles is implemented and maintained for such items whenever practical.

Unfortunately, many manufacturers do not wish to emphasize "Best Before" information . It therefore behooves the Builder's QMR to re-label boldly such information.

4.10.5 Packaging

Building envelope materials and/or components shall be marked according to documented guidelines to enable their prompt identification and use in required sequence at applicable building envelope or components assembly stages.

As a practical example of this, Simpson Strong Tie Ltd., manufacturer of fasteners and seismic restraints for wood frames, labels each incoming order of steel (after an exhaustive receiving inspection) with the product(s) that steel is destined to be used for. Thereafter it becomes very difficulty to misuse the material. Drywall suppliers often label the sides of drywall pallets with the suites they are intended for. It is not unreasonable for Builders to insist on similar packaging efforts generally.

4.15.7 Preservation

Building envelope materials and/or components owned by the Builder, its Customer or Supplier / Subcontractor shall be protected against possibility of deterioration or damage, when in safekeeping at the building site supervised by the Builder.

The preservation methods which apply to building envelope materials and/or components at building site include

a) suitable packaging of purchased or Customer-supplied product,
b) moisture or water damage elimination,
c) cushioning, supporting, strapping, blocking, crating,
d) use of tarpaulins, and
e) other methods, as deemed appropriate.

Immediate corrective steps shall be taken when an unacceptable degree of product quality deterioration is identified or foreseen.

4.10.6 Delivery

The Builder shall ensure readiness of the partially completed building envelope. A building envelope segment awaiting pre-delivery inspection shall be properly prepared and adequately protected against damage until such a time as its quality has been reviewed, and until the responsibility of the Builder for the building envelope has ceased in line with the terms and conditions specified in contractual agreements.

4.10.7 Handling, Storage, Packaging, Preservation and Delivery: Records

Records related to Handling, Storage, Packaging, Preservation and Delivery shall be maintained.

Specifically, the following records shall be maintained:

Item	Name	Responsibility
1./	Receiving Log	Shipper/Receiver
2./	Building Site Construction Log	Site Superintendent

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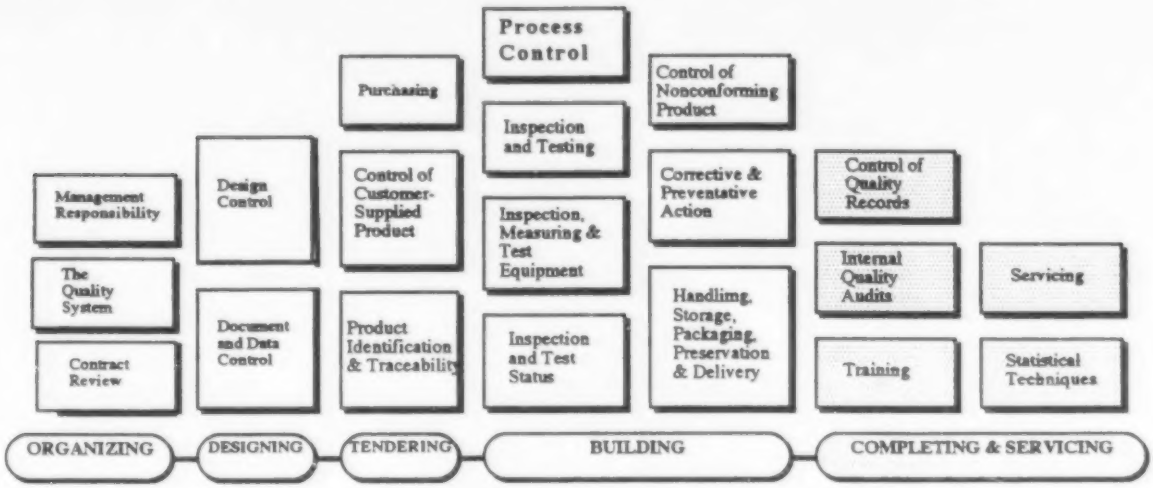
1 The Building Envelope Reviewer should probably have input to the determination of critical product.

2 Preparation of detailed review checklists is outside of the scope of this project. Good examples of such checklists may be found, for example, in the B.C. Wall and Ceiling Association (BCWCA) "Exterior Insulation and Finish System Inspection Program Reference Manual."

3 As is currently the case in Vancouver and New Westminster, with other municipalities leaning in this direction.

4 Everyone's standard specifications include clauses relating to these activities. Unfortunately, most are not followed or enforced. This Section highlights the principles of quality assurance rather than specific wording.

Chapter 5 COMPLETING & SERVICING QUALITY



THE QUALITY ASSURANCE PYRAMID

5.1 Control of Quality Records: Introduction

The need for properly maintained quality records is obvious. The Builder is expected to maintain evidence which demonstrates that a building envelope meets quality requirements, and that the quality system is operating effectively. If there is a need for the Builder to show that specific activities were performed, that required information has been recorded or that an outcome of activities has been met, these are the records which will provide required evidence.

The guidelines for collecting, storage, retrieval, retention, and disposition of records need to be defined. These guidelines shall be followed at the building site and at any other place where objective evidence of building envelope quality is generated (i.e. pertinent quality records from the subcontractor may constitute an element of these data).

Records may be in the form of any type of media, such as hard copy or electronic media. Records shall be legible and shall be stored and maintained in an environment that prevents damage, deterioration or loss.

Quality records shall be retained for a period of time which reflects needs of specific contract and/or supports evidence sought by applicable building code practices. Where agreed contractually, access to quality records shall be granted to the customer or the customer's representative for an agreed period.

The following are examples of the types of quality records requiring control: inspection records, test data, pre-occupancy completion / commissioning reports, design review and verification reports, material certificates (Certificates of Compliance), equipment calibration data, etc. The records, which give evidence that the building envelope or its specific stage has passed inspection and/or test within defined acceptance criteria, are of particular importance. The end of every section of this Quality Manual contains a requirement for specific quality records providing support for the quality system defined below.

5.1.1 Quality Records: Definition and Purpose

Quality records are defined as those documents demonstrating effects of activities performed by the Contractor:

- affecting directly or indirectly quality of the building envelope, i.e. project performance, building envelope stage completion, interim inspection and testing, pre-occupancy verification, commissioning reports, etc.
- documenting effective operation of the quality management quality system

Records pertaining to quality of the building envelope are represented by (but not limited to) the following:

- inspection and test records (receiving, in-process and final inspection and testing)
- purchased products or services certificates of compliance
- Corrective Action Requests (if any)
- Pre-occupancy report
- Building envelope commissioning report

5.1.2 Quality Records: Responsibility

The Site Superintendent and, in particular, the Site Foremen are responsible for maintaining control over and ensuring compliance with procedures relevant to the quality records within boundaries of their authority and responsibility.

The Contractor's Quality Management Representative (QMR) is responsible for setting up and maintaining quality records, as outlined in the relevant Sections of the Quality Manual.

5.1.3 Quality Records: Guidelines

Quality records shall be legible, easily identifiable and retrievable.

Quality records shall clearly demonstrate whether the building envelope or its specific stage has passed or failed defined inspection and test criteria (including evidence of non-conforming building envelope control, where applicable). This requirement

applies directly to the quality of project management activities as well as to the quality of building envelope controlled by these activities.

Traceability of the quality records shall be maintained, in order to provide:

- evidence of building envelope compliance with customer requirements, building codes and specifications
- documented disposition of non-conforming building envelope
- adequate and objective proof of the quality system effectiveness

The Quality Assurance Representative or delegate are the only personnel within the Builder's organization authorized to release the building envelope of its specific stage or to sign-off completion of the project stage. Quality records shall reflect this authority.

5.1.4 Quality Records: Retention, Disposal and Availability

Unless specifically required otherwise quality records providing evidence of the building envelope quality and compliance with related building codes, practices and regulations shall be retained for a minimum period of 10 (ten) years.[1]

No record of disposal after ten years is required, however, at the Contractor's discretion, obsolete quality records may be retained for an extended period of time and/or the Contractor may establish a documented evidence (list) of disposed records.

5.1.5 Quality Records: Storage

Quality records shall be stored in a suitable environment and maintained in a manner:

- protecting stored records against deterioration or damage
- ensuring access to the records by authorized personnel only
- providing continuity and traceability of stored information/data

Q-Tip - **Electronic quality records** (i.e. computer disks, laser discs or magnetic tapes) shall be:

- stored and maintained far from sources of magnetic or electrostatic field
- protected against deterioration and/or damage i.e. high temperature, humidity, etc.
- properly described and identified to enable their easy traceability and retrieval
- maintained by authorized personnel only, with restricted access to areas containing sensitive information and appropriate computer skills to prevent accidental data loss
- records stored directly on computer's data storage facility, i.e. mainframe, network/server or individual computers, shall be duplicated/backed-up at regular intervals in order to minimize loss of stored data in a case of computer failure. Backup tapes or disks shall be stored according to the above guidelines, preferably at a different and secure location, i.e. at home, at different building site or at Contractor administration office.

1 This is becoming the standard for building envelope warranties.

Quality records shall be reviewed periodically in order to assess their storage condition and prevent premature deterioration and loss of valuable data.

5.1.6 Quality Records: Evidence

The following records shall be maintained:

Item	Name	Responsibility
1./	Quality Records (as defined in applicable Sections of this Manual)	As nominated in relevant Sections of the Quality Manual

5.2 Internal Quality Audits

5.2.1 Internal Quality Audits: Introduction

Purpose of this Section - All the elements of a Building Envelope Provider's quality system should be internally evaluated on a regular basis. This quality system evaluation process is commonly referred to as Internal Quality Audits. An Internal Quality audit is in essence a simple check to see if the Building Envelope Provider follows the fundamental ISO 9000-series principles "say what you do, do what you say, and prove the above". [2]

Quality Manual Approach - Internal Quality Audits are one of planned" quality system activities" and an appropriate Internal Quality Audit Plan (Schedule) should be established by for their purpose. The format of the Internal Quality Audit Plan should define the specific areas to be audited and nominate the personnel carrying out audits.

In order to eliminate possibly biased opinions, the quality system elements shall be evaluated by personnel familiar with ISO 9001 requirements and independent of the specific activities or areas being audited.

Audit non-compliance or deficiencies identified during Internal Quality Audits should be documented and submitted for consideration by the company management. Reported discrepancies (if any) shall be reported and corrective action shall be taken in line with Section 4.14 of this Manual.

Values of this Section - Properly structured and implemented Internal Quality Audits are a powerful tool that can be used by the Building Envelope Provider to monitor their quality system. Not only their results provides Building Envelope Provider management with valuable information about how effectively their quality system works but they also offer an opportunity for further improvement which leads competent management towards increased competitiveness and financial gains.

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2 We are advised by a recently ISO 9001 certified engineer in Vancouver that the initial audit examined 100% of their processes, requiring 3 days to complete. Subsequently, 20% at random of procedures are audited each 6 monthss, meaning the entire quality system is reviewed over a 3 year cycle.

In very simple terms it is extremely wasteful to have a "quality system" which does not work. Such a system is not only costly in monetary terms but also it also becomes a source of continuos frustration of Contractor's personnel.

5.2.2 Internal Quality Audit: Purpose

The purpose of this procedure is to ensure that the quality system defined in this Quality Manual and implemented by the Contractor is effective, and that identified discrepancies (if any) are corrected in a timely manner.

The Quality Representative shall conduct internal Quality Audits of the Building Envelope Provider quality system. Their findings shall be reported to the Building Envelope Provider's senior management as a part of the Management Review process.

5.2.3 Internal Quality Audit: Responsibility

The Building Envelope Provider Quality Representative and/or authorized Building Envelope Provider personnel independent of those having direct responsibility for the audited area is responsible for conducting Internal Quality Audits.

The Building Envelope Provider personnel with responsibility for the audited area(s) shall assist auditing personnel in conducting Internal Quality Audits and take timely corrective and/or preventive action on discrepancies found during the audit

5.2.4 Internal Quality Audit: Procedure

Authorized Building Envelope Provider personnel shall:

a) perform Internal Quality Audits according to the Internal Quality Audit Plan
b) ensure that quality system, as defined in this Manual and related procedures, is followed and effective
c) identify discrepancies are reported to the Building Envelope Provider senior management.
d) ensure corrective and/or preventive action is taken in regard to identified discrepancies (if any)

Internal Quality Audits shall be documented on Internal Quality Audit Reports.

5.2.5 Internal Quality Audits: Records

Internal Quality Audit records, as defined in this Manual shall be maintained. Evidence shall be provided that quality system activities and that reported results comply with guidelines of this Quality Manual and related instructions.

The following records shall be maintained:

Item	Document	Responsibility
1./	Internal Quality Audit Report	Quality Management Representative
2./	Internal Quality Audit Plan	Quality Management Representative
3./	Corrective Action Request	Quality Management Representative

5.3 Training

5.3.1 Training: Introduction

Quality Manual Approach - Building Envelope Providers shall consider training all levels of personnel within an organization. Increased attention should be given to the selection and training of newly recruited personnel and personnel transferred to new assignments.
Training should provide:

- executive management with an understanding of the quality system.
- technical personnel with explanation of their contribution to the success of the quality system.
- site superintendents and building workers with guidelines regarding the methods and skills required to perform their tasks, i.e. operation of instruments, tools, and machinery they have to use, reading and understanding the documentation provided, the relationship of their duties to quality, and safety of the workplace.

Whenever appropriate, personnel should be certified in specialized operations such as welding, inspection, installation work, etc. Beyond completion of formal training programs or education, consideration should be given both to experience and demonstrated skills.

Training program need to be first defined, then followed. Training programs address identified training needs although the range of skills and knowledge which is required varies according to circumstances and the individual's role in the organization. Where appropriate, competence and skills should be demonstrated by examination, certification or testing/verification either in-house or by a recognized outside party.

A properly designed training program for building site personnel should:
- reflect the interchangeability of trained personnel to satisfy the company's needs.
- include housekeeping, safety, reporting, etc. as required.
- ensure that quality policy is understood at all levels of the organization.

Training records, including achievement of required skill levels should be maintained.

5.3.2 Training: Purpose and Policy

This procedure defines a Building Envelope Provider's policy with regard to the training of personnel who provide labour and services on a building site .

The Building Envelope Provider' shall ensure that the knowledge and skills of personnel performing activities affecting quality meet internal company needs as well as customer requirements and expectations.

The Building Envelope Provider' conducts training of employees aimed at:

a) maintaining specified standards of quality
b) maximizing use of available skills, experience and expertise
c) improving the availability of personnel with interchangeable capabilities

5.3.3 Training: Responsibility

For a Builder, it shall be the responsibility of the Site Superintendent to ensure compliance with this procedure. For other Building Envelope Provider's, the QMR shall have this responsibility.

The Site Superintendent, within the area of authority, shall ensure that:

a) training requirements for supervised personnel are identified
b) the QMR is informed about identified training needs
c) interchangeability of the personnel is established and maintained
d) training and skills records are maintained

Authorized building site administration personnel shall convert identified training requirements into suggested training program(s), and monitor these programs within allocated finances. The Site Superintendent should also be responsible for review and endorsement of training program(s) and for allocation of adequate funds for training purposes.

A Training Program is required for all employees, including managerial and technical staff, as appropriate.

5.3.4 Training: Procedure

Adequate resources shall be allocated to ensure that Company training needs are met, as planned.

Assessment of training needs shall address employee interchangeability. Availability of trained personnel equipped with interchangeable skills shall ensure that there are always personnel equipped with appropriate skills to reduce the impact of temporary shortages in human resources at the building site. The Site Superintendent shall

maintain a list of qualified personnel and subcontractors who may provide additional qualified human resources in such circumstances.

Contract employees shall complete Introduction Training program providing information about the Company, with specific emphasis on its quality system. Skills of personnel delegated to perform specific duties shall be qualified on the basis of possessed education, training and/or experience.

Identified training needs shall be documented in personnel training records, summarized on Personnel Skills Inventory records, and reflected in the Contractor's Training Program.

5.3.5 Training: Records

The following records shall be maintained:

I.	Document	Responsibility
1./	Personnel Training Records	Building Site Administration
2./	Training Program	Site Superintendent
3./	Personnel Skills Inventory	Building Site Administration

5.4 Servicing

5.4.1 Servicing: Introduction

INTRODUCTION

ISO 9001; 1994 in Section 4.19 states *"Where servicing is a specified requirement, the supplier shall establish and maintain documented procedures for performing, verifying and reporting that the servicing meets the specified requirements"*. Notwithstanding that ISO requires it, common sense demands servicing become a part of the approach to each Project. The CMHC Building Failures study pinpointed poor maintenance or lack of maintenance as a contributing factor to some building envelope failures.

Key Concepts -

- If a Building Envelope Provider's obligation defined in contractual agreement include guarantee or warranty of the building envelope, then ISO 9000-series requirements related to servicing are applicable.
- This requirement may be extended even further if the Building Envelope Provider' is committed by regulations/legislation to provide service in any form i.e. installation, commissioning, after-sales service, warranty repairs etc.

Quality Manual Approach - This Section of the Quality Manual may be applied to both internal and external services of the Building Envelope Provider. The nature of the services provided is defined as follows:

* A service which is subject to customer evaluation
* The process by which the service is delivered to the end user

Post-commissioning warranty for a building envelope shall confirm assurances regarding timely repair of defects which become known after the building completion.

Whenever applicable, the following guidelines shall be considered:

- customer needs in regards to building envelope post-commissioning services shall be identified and documented
- the nature and extent of required services shall be clearly defined and constitute part of the contractual agreement
- responsibility for servicing should be clearly defined and information regarding where to lodge complaints related to the building envelope warranty shall be provided
- a simple procedure for reporting and handling warranty complaints shall be established
- adequate resources shall be secured for warranty / servicing purpose. Response to this requirement may take form of alternative arrangements made by the Contractor with subcontractors specializing in such services.
- personnel involved in servicing activity shall be adequately trained
- records of service / warranty activities shall be maintained

Value of this Section -
Requirements of this ISO 9001 Section may not apply to a Building Envelope Provider whose products do not fall into the coverage by guarantees or warranties. Defining what are "specified requirements" which trigger applicability of this Section may be an eye-opening exercise.

5.4.2 Servicing: Purpose

The purpose of these procedures is to ensure that, whenever contractually required, service activities provided by the Contractor :

a) are performed according to the documented procedures

b) meet contractual requirements

The procedures apply to all technical support activities related to the building envelope warranty.

5.4.3 Servicing: Responsibility

The Building Envelope Provider's Quality Management Representative (QMR) with responsibility for warranty shall be directly responsible for quality, efficiency and adequacy of service to the building envelope provided under terms and conditions specified in contractual agreement.

5.4.4 Servicing: Procedure

It is the policy of the Building Envelope Provider' that all warranty-related activities provided by the Building Envelope Provider' or its authorized service outlets shall follow the guidelines defined in this procedure.

The Building Envelope Provider' may delegate responsibility for service to a selected and approved sub-contractor familiar with the specifications, quality practices and procedures applicable to building envelope.

Q-Tip - **Suitability of any Subcontractors** engaged by the Building Envelope Provider' to carry out warranty services should be evaluated and this information included on the Approved Suppliers List . This may be a subcontracted service (and a very important one) for which the Building Envelope Provider will carry full responsibility, therefore selection of a suitable Subcontractor is critical from the point of view of future warranty performance and customer satisfaction (or lack of it).

The Building Envelope Provider' management shall periodically review Service activities and relevant records.

Q-Tip - - **KEEPING TRACK OF WARRANTY DATES** - The cover page of any maintenance manuals should include a simple to read table with warranty expiry dates for various building envelope elements noted on it.

Q-Tip - **BUILDING MAINTENANCE MANUAL OR CAR MAINTENANCE MANUAL - WHAT'S THE DIFFERENCE?** Most automobiles come with a clear table of maintenance requirements required after certain mileages or ages. From the auto world we also have the concepts of spring tune-up and winter tune-up. There is no reason building envelope maintenance manuals could not have similar maintenance tables and suggestions for regular "tune-ups."

Whenever defined in contractual agreement, servicing activities shall meet specific customer requirements and agreed building envelope Warranty Terms and Conditions.

Q-Tips - **IDENTIFYING HIGH MAINTENANCE ITEMS** - This may be a tricky item in the context of liability. Section 4.4 "Designing for Quality" has suggested identifying where selected details/materials vary from Best Practice Guide recommendations. This may provide a clue to items more likely to be high maintenance. But high maintenance should not automatically be seen as wrong - many traditional designs with enduring appeal exhibit high maintenance details and/or materials. On balance, we believe it is better to identify items/areas needing more or more frequent attention - the alternative may be a leaky building envelope. If such items have been identified and accepted at the design stage, then their identification should endure to this phase of a Project, meaning that most servicing issues will have already been identified and addressed.

5.4.5 Servicing - Records

The following records shall be maintained:

Item	Name	Responsibility
1./	Warranty Records	The Quality Management Representative
2./	Warranty Terms & Conditions	The Quality Management Representative

5.5 Statistical Techniques

5.5.1 Statistical Techniques: Introduction

Use of statistical techniques in modern quality systems is compulsory (it is NOT one of these requirements, which start from words "where appropriate". Statistical techniques are required to "*...establish, controll and verify process capability and product characteristics...*".

A typical building site, and the process of constructing a building envelope in particular, has very limited need for the use of statistical techniques. Verification of product characteristics is a different matter and some simple statistical methods should be applied. Additionally, Designers may find a need for the use of more sophisticated statistical techniques for environmental tests (rain, moisture content, wind, earthquake, erosion, etc.), building mockup tests, communication (traffic, pedestrians, etc.), noise and magnetic field evaluation or analysis of statistical data related to durability and reliability of mechanical components of the designed buildings (escalators, elevators, gensets, etc.).

There is a wide choice of available statistical techniques ranging from simple data collection sheets to complex capability studies, failure mode analysis methods and exercises in the design of experiments. The decision which one will be the most suitable from the Building Envelope Provider's point of view is an important one and should be taken with a lot of thought, as it usually triggers serious demands for resources and its effects may have broad legal and financial implications.

Correct application of statistical techniques should be extended to the post-construction (post-commissioning) stages and may be used for purposes such as: market analysis, determination of quality levels, inspection data analysis, safety evaluation, risk analysis, project performance monitoring and assessment, etc.

In general, the building envelope Contractor is expected to ensure proper selection and effective use of suitable statistical techniques for the verification of conformance of the product.

The use of control charts and statistical sampling plans are examples of techniques employed to facilitate Statistical Process Control.

5.5.2 Statistical Techniques: Purpose

The purpose of this procedure is to define the selection and use of selected statistical techniques suitable for verifying conformance of the building envelope quality to specified requirements.

Statistical techniques selected by the Contractor are used for:

a) construction / project progress monitoring
b) inspection activities at defined stages of building envelope construction
c) investigation of the Corrective Action Requests
d) monitoring of quality performance

5.5.3 Statistical Techniques: Responsibility

The Quality Management Representative shall:

a) identify need for use of statistical techniques, their selection and implementation

b) collect and, where appropriate, analyze gathered statistical data

c) communicate results of statistical analysis

The Site Superintendent shall ensure that:

a) all personnel utilizing statistical techniques (i.e. checksheets) are trained in their use

b) whenever required, assistance is provided to the Quality Assurance Department in gathering statistical data

c) adequate resources are allocated for training of the personnel in selected statistical techniques.

5.5.4 Statistical Techniques: Guidelines

Q-Tip - **A Note about Technique** - Statistical techniques vary from very simple to very complex. The Contractor should use "horses for courses" criteria to select statistical techniques which are the right ones for specific project. This selection may vary from project to project depending on unique needs of specific work.

The most sophisticated statistical techniques are not necessarily the best and, if incorrectly selected, may create circumstances when valuable resources are wasted. It will be safe to assume that, unless specific project needs dictate otherwise, simple checksheets (i.e. inspection or work progress checksheets), simple diagrams (histogram, bar graph, line graph), and simple data collection sheets (i.e. log books) will be the most suitable ones and will most likely address the basic needs of typical Building Envelope Provider. It has to be remembered however that even these simple techniques need instructions and training in their use. Otherwise all effort in their implementation and dedicated to statistical data collecting will be wasted.

The statistical techniques noted below are selected for building envelope quality verification purposes:

	Techniques:	Applications:
a)	Diagrams progress, supplier, etc.)	Performance monitoring (project
b)	Data collection sheets progress monitoring	Receiving inspection, corrective action
c)	Inspection Check Sheets completion, commissioning	Inspection and test, quality audits, work

5.5.5 Statistical Techniques: Records

The Quality Assurance Department shall maintain the following records, either manual or electronic:

I	Document	Responsibility
a)	Inspection Check Sheets	Construction Personnel / Quality Management Representative
b)	Data Analysis Records	Quality Management Representative

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CORRECTIVE ACTION REPORT LOG

CAR #	DATE ISSUED	BRIEF DESCRIPTION OF THE PROBLEM	ORIG. DEP'T.	CRITICAL PROBLEM		CAR STATUS				DATE COMPLETED
—	dd / mm / yy	—	---	YES	NO	A	B	C	D	dd / mm / yy
	__ / __ / __									__ / __ / __
	__ / __ / __									__ / __ / __
	__ / __ / __									__ / __ / __
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Status Codes: A - Problem described / reported B - Investigation completed - corrective / preventive action determined
C - Corrective / preventive action introduced D - Effectiveness of the corrective / preventive action verified

PAGE: _____

[Company Logo] [Company address] [Company tel/fax/e-mail] **QM Rep:** **Tel/ fax/ e-mail:**	***QUALITY PLAN*** *- Date issued: October 1, 1998* **Project Name:** **Project Address:** **Customer Name:** **Customer Address:** **Customer Tel/fax/e-mail:** **Customer QM Rep.:** **QM Rep. tel/ fax/ e-mail**

Ref.	Responsibility	Due	Done	Responsible Parties						
				C	D	GC	1	2	3	4
1.1	**Management responsibility**									

1.1[1]	**Management responsibility**	Due[2]	Done[3]	C[4]	D[5]	GC[6]	1[7]	2[8]	3[9]	4[10]
1.1.1	Quality Policy (QP)			11						
	Develop Company wide QP									
	Develop Project QP									
1.1.3	Organization									
	Appoint Company wide QMR									
	Appoint Project QMR									
	Advise Customers of any QMR Changes									
1.1.4	Management Review									

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1 This is where to place the Quality Manual/ ISO Reference, so that a user can refer to the full text for explanations of responsibilities.

2 Insert any known "Due" date in this column as a reminder

3 "Done" can be checked off or initialed when complete, as appropriate

4 **C = Customer**: [QM Rep. Name/contact info]

5 **D = Designer:** [QM Rep. Name/contact info]

6 **GC = General Contractor:** [QM Rep. Name/contact info]

7 **1** = [QM Rep. Name/contact info]

8 **2** = [QM Rep. Name/contact info]

9 **3** = [QM Rep. Name/contact info]

10 **4** = [QM Rep. Name/contact info]

11 Insert here an indication has to who has direct responsibility for a phase/step, and who is a contributor. For example, direct responsibility might be a **4** mark, a contributor might be an **X**

[Company Logo] [Company address] [Company tel/fax/e-mail] **QM Rep:** **Tel/ fax/ e-mail:**	***QUALITY PLAN*** *- Date issued: October 1, 1998* **Project Name:** **Project Address:** **Customer Name:** **Customer Address:** **Customer Tel/fax/e-mail:** **Customer QM Rep.:** **QM Rep. tel/ fax/ e-mail**

Ref.	Responsibility	Due	Done	Responsible Parties						
1.2	**Quality system**			C	D	GC	1	2	3	4

1.2[1]	**Quality system**	Due[2]	Done[3]	C[4]	D[5]	GC[6]	1[7]	2[8]	3[9]	4[10]
1.2.1	GENERAL[11]			[12]						
	Prepare Project Quality Manual									
1.2.2	Name Project QMR									
1.2.3	Prepare Overall Quality Plan									
1.2.4	Prepare Project Quality Plan									

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12 Insert here an indication has to who has direct responsibility for a phase/step, and who is a contributor. For example, direct responsibility might be a 4 mark, a contributor might be an X

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Ref.	Responsibility	Due	Done	Responsible Parties						
				C	D	GC	1	2	3	4
1.3	CONTRACT REVIEW									

1.3[1]	Contract review	Due[2]	Done[3]	C[4]	D[5]	GC[6]	1[7]	2[8]	3[9]	4[10]
1.3.3	General assessment of capabilities[11]			12						
	QMR nominated									
	Channels for communication[13]									
1.3.3	Contract Procedure									
	Pre-Bid activities									
	Resolved differences									
	Amendments documented[14]									
	Contract review records maintained									
	Pre-Bid/Bid									
	Contract									
1.3.5	Project records									
1.3.7	Quality/Cost Balancing									
	Nominated resp. in-house									
	Resolved anomalies[15]									

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12 Insert here an indication has to who has direct responsibility for a phase/step, and who is a contributor. For example, direct responsibility might be a 4 mark, a contributor might be an X

13 These should be recorded right in the Quality Plan.

14 These should be referenced here.

15 These should be listed right here. also how they were resolved.

[Company Logo] [Company address] [Company tel/fax/e-mail] **QM Rep:** **Tel/ fax/ e-mail:**	***QUALITY PLAN*** *- Date issued: October 1, 1998* **Project Name:** **Project Address:** **Customer Name:** **Customer Address:** **Customer Tel/fax/e-mail:** **Customer QM Rep.:** **QM Rep. tel/ fax/ e-mail**

Ref.	Responsibility	Due	Done	Responsible Parties						
				C	D	GC	1	2	3	4
2.1	**DESIGN CONTROL**									

[Company Logo] [Company address] [Company tel/fax/e-mail] **QM Rep:** **Tel/ fax/ e-mail:**	***QUALITY PLAN*** **- *Date issued: October 1, 1998*** **Project Name:** **Project Address:** **Customer Name:** **Customer Address:** **Customer Tel/fax/e-mail:** **Customer QM Rep.:** **QM Rep. tel/ fax/ e-mail**

Ref.	Responsibility	Due	Done	Responsible Parties						
				C	D	GC	1	2	3	4
2.1	DESIGN CONTROL									

2.1[1]	**Design Control**	Due[2]	Done[3]	C[4]	D[5]	GC[6]	1[7]	2[8]	3[9]	4[10]
	GENERAL[11]			12						
	Liaison with Quality Plan									
2.3	DESIGN PLANNING									
	Creation of Design Plan - Determining project delivery method - Scoping Building Envelope portion									
2.3.1	SCHEMATIC DESIGN									
	Design Input - Liaison with Customer re Design - Review of programming information - Establishment of basic design concept									
	Design Output									
	Design Review - Comparison with BPG details & recording of variations									
	Design Verification[13]									
2.3.2	DESIGN DEVELOPMENT									
	Selection of engineering systems									
	Selection of materials and finishing systems									
	Design Development Output									
	Design Development Review									
	Design Development Verification									
2.3.3	WORKING DRAWINGS & SPECIFICATIONS									
	Maintain design concepts in drawings and specs.									
	Working Drawing Output									
	Working Drawing Review									

[Company Logo] [Company address] [Company tel/fax/e-mail] **QM Rep:** **Tel/ fax/ e-mail:**	***QUALITY PLAN*** *- Date issued: October 1, 1998* **Project Name:** **Project Address:** **Customer Name:** **Customer Address:** **Customer Tel/fax/e-mail:** **Customer QM Rep.:** **QM Rep. tel/ fax/ e-mail**

Ref.	Responsibility	Due	Done	Responsible Parties						
2.1	**DESIGN CONTROL**			C	D	GC	1	2	3	4
	Working Drawing Verification									
	DESIGN VALIDATION									
	Maintenance of envelope design concepts									
	Mockup / Submittal design									
	Mockup / Submittal preparation									
	Mockup / Submittal Review									
	Mockup / Submittal Verification									
2.3.5	COMMISSIONING									
	Record Drawings									
	As-Built Drawings									

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13 This become the location for sign - off.

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Ref.	Responsibility	Due	Done	Responsible Parties						
				C	D	GC	1	2	3	4
2.12	**Document & Data Control**									

2.12[1]	**Document & Data Control**	Due[2]	Done[3]	C[4]	D[5]	GC[6]	1[7]	2[8]	3[9]	4[10]
	Establish & maintain Document Log[11]			12						
	Establish/ Use of Controlled Doc. Stamp									
	Establish/maintain Documents Records									

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[Company Logo] [Company address] [Company tel/fax/e-mail] **QM Rep:** **Tel/ fax/ e-mail:**	***QUALITY RESPONSIBILITY MATRIX*** **Project Name:** **Project Address:** **Customer Name:** **Customer Address:** **Customer Tel/fax/e-mail:** **Customer QM Rep.:** **QM Rep. tel/ fax/ e-mail**

Ref.	Responsibility	Due	Done	Responsible Parties						
3.1	**BUYING QUALITY - Purchasing**			C	D	GC	1	2	3	4

3.1[1]	**Purchasing**	Due[2]	Done[3]	C[4]	D[5]	GC[6]	1[7]	2[8]	3[9]	4[10]
	Document Purchasing activities[11]			12						
	Establish supplier assessment criteria									
	Assess suppliers & maintain assessment records									
	Ensure purchasing includes relevant envelope data[13]									
	Verify quality of received goods & services[14]									
	Establish & maintain purchasing records									

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13 Use the Submittal Review form in the Forms section of this Manual to assist with this.

14 See also Section 4.10 - Receiving Inspection

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Ref.	Responsibility	Due	Done	Responsible Parties						
3.2	**Control of Customer-Supplied Product**			C	D	GC	1	2	3	4

3.2[1]	**Control of Customer-Supplied Product**	Due[2]	Done[3]	C[4]	D[5]	GC[6]	1[7]	2[8]	3[9]	4[10]
	Establish/ communicate acceptance policy for customer-supplied product			11						
	Maintain records re customer-supplied product									

---

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[Company Logo] [Company address] [Company tel/fax/e-mail] **QM Rep:** **Tel/ fax/ e-mail:**	***QUALITY PLAN*** *- Date issued: October 1, 1998* **Project Name:** **Project Address:** **Customer Name:** **Customer Address:** **Customer Tel/fax/e-mail:** **Customer QM Rep.:** **QM Rep. tel/ fax/ e-mail**

Ref.	Responsibility	Due	Done	Responsible Parties						
3.3	**Product Identification & Traceability**			C	D	GC	1	2	3	4

3.3[1]	Pdt. ID & Traceability	Due[2]	Done[3]	C[4]	D[5]	GC[6]	1[7]	2[8]	3[9]	4[10]
	Establish guidelines for identification & communicate to all QMR's			[11]						
	Maintain ID/Trace records									

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Ref.	Responsibility	Due	Done	Responsible Parties						
				C	D	GC	1	2	3	4
4.1	**BUILDING QUALITY - Process Control**									

4.1[1]	**BUILDING QUALITY - Process Control**	Due[2]	Done[3]	C[4]	D[5]	GC[6]	1[7]	2[8]	3[9]	4[10]
	Identify and disseminate the Project water management strategy[11]			12						
	Disseminate Work Instructions									
	Maintain a Construction Work Log Book									
	Maintain inspection records									
	Evaluate the project delivery model for impacts on process control									
	Coordinate subcontracts with related work scopes									
	Maintain & distribute a QMR[13] directory									
	Maintain a construction schedule in a sequencing fashion appropriate to the building envelope									
	Label design drawings as to critical bldg. envelope elements									
	Select detail size for dissemination ease									
	Coordinate feedback re envelope drawings									
	Incorporate water management strategy on permitting documents									
	Communicate alternative/substitution requests to the BER[14]									
	Review envelope reqts. at first site meeting									
	Design & construct envelope mock-up('s), evaluate and refine envelope as required									
	Maintain change list/log and chart progress									
	Clarify envelope cutting & patching specs.									
	Copy BER with change correspondence									
	Copy affected QMR's with change correspondence									
	Copy BER with permit amendments									
	Prepare and log required submittals									
4.9.5-8b/c	Instruct shop dwg. submitters re pre-engineering reqts. and seal reqts.									

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Ref.	Responsibility	Due	Done	Responsible Parties						
				C	D	GC	1	2	3	4
4.1	**BUILDING QUALITY - Process Control**									
	Prepare list of req'd BER field reviews[15] & maintain log of status[16]									
	Distribute field review reports to affected QMR's[17]									
	Prepare list of warranty/maintenance requirements[18]									
	Collect maintenance information during Project progress[19]									
	Organize pre-occupancy review of envelope trades									

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11 It is expected each subscriber to the Protocol will amend these requirements to match their involvement.

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13 QMR = Quality Management Representative

14 BER = Building Envelope Reviewer

15 This list should probably be prepared by the BER

16 The BER may wish to maintain a log, but in any event there should be one posted prominently on site

17 As some of the QMR's will be subcontracted to the Builder, and some will be consultants to the Owner, distribution should probably be by the BER to the consultants and the Site Superintendent to the Subcontractors, Suppliers and Installers.

18 If this is not explicit in the specifications, it should probably be prepared by the BER

19 This should be a Site Superintendent or Builder QMR activity

[Company Logo] [Company address] [Company tel/fax/e-mail] **QM Rep:** **Tel/ fax/ e-mail:**	***QUALITY PLAN*** *- Date issued: October 1, 1998* **Project Name:** **Project Address:** **Customer Name:** **Customer Address:** **Customer Tel/fax/e-mail:** **Customer QM Rep.:** **QM Rep. tel/ fax/ e-mail**

Ref.	Responsibility	Due	Done	Responsible Parties						
4.2	**Inspection & Testing**			C	D	GC	1	2	3	4

4.2[1]	**Inspection & Testing**	Due[2]	Done[3]	C[4]	D[5]	GC[6]	1[7]	2[8]	3[9]	4[10]
	Receiving Inspection[11]			12						
	Be responsible for receiving inspection									
	Identify "critical" product									
	Determine level of inspection effort									
	Obtain Conformance Cert.[13]									
	Maintain Receiving Inspection Log									
	Communicate quality requirements to Suppliers									
	Perform receiving inspections									
	Advise Suppliers as to results of Receiving inspections									
	In Process Inspection									
	Be responsible for in-process inspections[14]									
	Perform Patrol Inspections									
	Perform in-process inspections and report results to affected parties									
	Maintain records of in-process inspections									
	Review defective elements when corrected									
	Final Inspection and Testing									
	Be responsible for final inspection/ testing									
	Define scope of final inspection/ testing									
	Perform final inspection and testing									
	Verify satisfactory completion or identify nonconforming installations									
	Review defective work when corrected									
	Maintain records of final inspection and testing									

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[Company Logo] [Company address] [Company tel/fax/e-mail] **QM Rep:** **Tel/ fax/ e-mail:**	***QUALITY PLAN*** *- Date issued: October 1, 1998* **Project Name:** **Project Address:** **Customer Name:** **Customer Address:** **Customer Tel/fax/e-mail:** **Customer QM Rep.:** **QM Rep. tel/ fax/ e-mail**

Ref.	Responsibility	Due	Done	Responsible Parties						
4.2	**Inspection & Testing**			C	D	GC	1	2	3	4

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13 List items requiring Certificate of Conformance
14 In most circumstances there will be several reviewers providing in-process inspection services. The activities requiring in-process inspection should be listed, plus the responsible party.

[Company Logo] [Company address] [Company tel/fax/e-mail] **QM Rep:** **Tel/ fax/ e-mail:**	***QUALITY PLAN*** *- Date issued: October 1, 1998* **Project Name:** **Project Address:** **Customer Name:** **Customer Address:** **Customer Tel/fax/e-mail:** **Customer QM Rep.:** **QM Rep. tel/ fax/ e-mail**

Ref.	Responsibility	Due	Done	Responsible Parties						
4.6	**Inspection, measuring & test equipment**			C	D	GC	1	2	3	4

4.6[1]	**Inspection, measuring & test equipment**	Due[2]	Done[3]	C[4]	D[5]	GC[6]	1[7]	2[8]	3[9]	4[10]
	Establish party responsible for activities[11]			12						
	Identify eqpt. needing calibration									
	Establish calibration frequency									
	Log calibration activities									
	Keep calibration logs									

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Ref.	Responsibility	Due	Done	Responsible Parties						
4.7	**Inspection & test status**			C	D	GC	1	2	3	4

4.7[1]	**Inspection & test status**	Due[2]	Done[3]	C[4]	D[5]	GC[6]	1[7]	2[8]	3[9]	4[10]
	Maintain inspection status of purchased materials[11]			12						
	Maintain inspection status of pre-fab'd and assembly pdts.									
	Maintain inspection status of final insp., commissioning									
	Maintain inspection and test records									

---

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Ref.	Responsibility	Due	Done	Responsible Parties						
				C	D	GC	1	2	3	4
4.8	**Control of Nonconforming product**									

4.8[1]	**Control of Nonconforming product**	Due[2]	Done[3]	C[4]	D[5]	GC[6]	1[7]	2[8]	3[9]	4[10]
	Confirm responsibility for nonconforming product[11]			12						
	Maintain non-conforming procedures									
	Maintain non-conforming records									

---

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Ref.	Responsibility	Due	Done	Responsible Parties						
				C	D	GC	1	2	3	4
4.9	Corrective & preventative action									

4.9[1]	Corrective & preventative action	Due[2]	Done[3]	C[4]	D[5]	GC[6]	1[7]	2[8]	3[9]	4[10]
	Develop CAR form/ procedure[11]			12						
	Report problems on CAR forms									
	Log CAR									
	Investigate problem in CAR									
	Implement solutions to identified problems									
	Change existing practices and procedures to reduce future problems									
	Confirm completion of remedial work									
	Keep records of CAR's and LOgs									

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Ref.	Responsibility	Due	Done	Responsible Parties						
				C	D	GC	1	2	3	4
4.10	**Handling, Storage, packaging, preservation & delivery**									

4.10[1]	**Handling, Storage, packaging, preservation & delivery**	Due[2]	Done[3]	C[4]	D[5]	GC[6]	1[7]	2[8]	3[9]	4[10]
	Establish responsibility for Handling activities[11]			12						
	Determine Product handling requirements									
	Verify appropriate Handling									
	Determine Product storage requirements									
	Verify appropriate storage									
	Determine Product packaging requirements									
	Verify appropriate packaging									
	Determine Product preservation requirements									
	Verify appropriate preservation									
	Determine Product delivery requirements									
	Verify appropriate delivery									
	Maintain Handling records.									

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Ref.	Responsibility	Due	Done	Responsible Parties						
				C	D	GC	1	2	3	4
5.1	**Control of Quality records**									

5.1[1]	Control of Quality records	Due[2]	Done[3]	C[4]	D[5]	GC[6]	1[7]	2[8]	3[9]	4[10]
	Define responsibility for quality record establishment and maintenance[11]			12						
	Develop the template of quality records in accordance with defined principles									
	Define retention and disposal policies									
	Determine need for a disposal record and implement as appropriate									
	Establish and maintain appropriate storage facilities									
	Maintain quality records defined in the Quality Manual									

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10 **4** = [QM Rep. Name/contact info]

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12 Insert here an indication has to who has direct responsibility for a phase/step, and who is a contributor. For example, direct responsibility might be a **4** mark, a contributor might be an **X**

[Company Logo] [Company address] [Company tel/fax/e-mail] **QM Rep:** **Tel/ fax/ e-mail:**	***QUALITY PLAN*** *- Date issued: October 1, 1998* **Project Name:** **Project Address:** **Customer Name:** **Customer Address:** **Customer Tel/fax/e-mail:** **Customer QM Rep.:** **QM Rep. tel/ fax/ e-mail**

Ref.	Responsibility	Due	Done	Responsible Parties						
5.2	**Internal quality audits**			C	D	GC	1	2	3	4

5.2[1]	**Internal quality audits**	Due[2]	Done[3]	C[4]	D[5]	GC[6]	1[7]	2[8]	3[9]	4[10]
	Establish responsibility for conducting internal audits & taking corrective measures[11]			12						
	Perform internal quality audits									
	Maintain audit records									

---

1 This is where to place the Quality Manual/ ISO Reference, so that a user can refer to the full text for explanations of responsibilities.

2 Insert any known "Due" date in this column as a reminder

3 "Done" can be checked off or initialed when complete, as appropriate

4 **C = Customer:** [QM Rep. Name/contact info]

5 **D = Designer:** [QM Rep. Name/contact info]

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[Company Logo] [Company address] [Company tel/fax/e-mail] **QM Rep:** **Tel/ fax/ e-mail:**	***QUALITY PLAN*** *- Date issued: October 1, 1998* **Project Name:** **Project Address:** **Customer Name:** **Customer Address:** **Customer Tel/fax/e-mail:** **Customer QM Rep.:** **QM Rep. tel/ fax/ e-mail**

Ref.	Responsibility	Due	Done	Responsible Parties						
				C	D	GC	1	2	3	4
5.3	**Training**									

5.3[1]	**Training**	Due[2]	Done[3]	C[4]	D[5]	GC[6]	1[7]	2[8]	3[9]	4[10]
	Identify training needs[11]			12						
	Assess training levels of staff & develop list of substitutes to cover unforeseen reqts.									
	Maintain training records									
	Maintain Personnel Skills Inventory									

---

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[Company Logo] [Company address] [Company tel/fax/e-mail] **QM Rep:** **Tel/ fax/ e-mail:**	***QUALITY PLAN*** *- Date issued: October 1, 1998* **Project Name:** **Project Address:** **Customer Name:** **Customer Address:** **Customer Tel/fax/e-mail:** **Customer QM Rep.:** **QM Rep. tel/ fax/ e-mail**

Ref.	Responsibility	Due	Done	Responsible Parties						
5.4	**Servicing**			C	D	GC	1	2	3	4

5.4[1]	**Servicing**	Due[2]	Done[3]	C[4]	D[5]	GC[6]	1[7]	2[8]	3[9]	4[10]
	Delegate responsibility for servicing[11]			12						
	Be responsible for servicing									
	Establish guidelines for provision of servicing activities									
	Establish and maintain list of approved servicing providers									
	Periodically review service activities, records and servicing provider lists and performance[13]									
	Monitor customer satisfaction with servicing									
	Amend servicing policies where customers are dissatisfied									

---

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13 Choose a suitable periodic time frame for review - a minimum of annually is recommended.

[Company Logo] [Company address] [Company tel/fax/e-mail] **QM Rep:** **Tel/ fax/ e-mail:**	***QUALITY PLAN*** *- Date issued: October 1, 1998* **Project Name:** **Project Address:** **Customer Name:** **Customer Address:** **Customer Tel/fax/e-mail:** **Customer QM Rep.:** **QM Rep. tel/ fax/ e-mail**

Ref.	Responsibility	Due	Done	Responsible Parties						
5.5	**Statistical Techniques**			C	D	GC	1	2	3	4

5.5[1]	**Statistical Techniques**	Due[2]	Done[3]	C[4]	D[5]	GC[6]	1[7]	2[8]	3[9]	4[10]
	Define the selection and use of selected statistical techniques suitable for verifying conformance of the building envelope quality to specified requirements.[11]			12						
	Identify need for use of statistical techniques, their selection and implementation									
	collect and, where appropriate, analyze gathered statistical data									
	communicate results of statistical analysis									
	Ensure that all personnel utilizing statistical techniques (i.e. checksheets) are trained in their use									
	Ensure that whenever required, assistance is provided to the Quality Assurance Department in gathering statistical data									
	Ensure that adequate resources are allocated for training of the personnel in selected statistical techniques.									

---

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2 Insert any known "Due" date in this column as a reminder

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[Company Logo] [Company address] [Company tel/fax/e-mail] **QMR Rep:** **Tel/ fax/ e-mail:**	**BUILDING ENVELOPE DESIGN REVIEW MEETING** **Date:** **Project Name:** **Project Address:** **Customer Name:** **Customer Address:** **Customer Tel/fax/e-mail:** **Customer QMR Rep.:** **QMR Rep. tel/ fax/ e-mail**

ATTENDEES: (List)

1. GENERAL:[1]

1.1. ACTION ALL

NOTE the following building envelope scope of work undertaken by The Building Envelope Reviewer:[2]

1. DOCUMENT REVIEW/ SITE VISIT

We will review the design drawings and specifications provided (one occasion) and advise in writing of any area(s) where we believe them to be deficient as regards the intent of Bulletin 96-02, Bulletin 96-25 and VBBL Part 5[3], and also in relation to other current building envelope design principles and practices.

2. TEAM MEETING

After submitting our report, we will meet on [ ] occasion(s) with the Quality Management Representatives of the Designers/ Builders/ Suppliers and/or Installers[4] and others invited by them to review our report, suggested design details[5], procedures, materials, systems, our recommendations and expectations for the project's building envelope. We will minute these meetings and use these minutes as the basis for our subsequent services and reviews.

3. ACCEPTANCE OF DOCUMENTS

We will consult with the Designers/ Builders/ Suppliers and/or Installers and/or their Quality Management Representatives by phone and fax and review additional or revised details and specifications provided as a consequence of our document review & team meeting, and confirm their acceptance in writing. We will copy our correspondence to the appropriate Quality Management Representatives.

4. CONSTRUCTION SITE MEETING

After the acceptance of documents, we will attend a site meeting including the Quality Management Representatives of the Designers/ Builders/ Suppliers and/or Installers and others invited by them to review recommended site practices, minimum inspection requirements, submittal requirements, etc. We will minute these meetings and use these minutes as the basis for our subsequent services and reviews.

5. CONSTRUCTION MOCK-UP'S:

Since the project documents may not address the sequence of construction (as noted in Bulletins 96-02 and 96-25), we will liaise with the Builder as regards appropriate construction sequences and methods which need to be verified through prototype or mock-up. A sample of the elements in question will be constructed for our review and acceptance. This sample will be used as the standard for the balance of the project.

6. FIELD REVIEW & CERTIFICATION:

We will perform the ongoing field reviews required by VBBL Part 5 and P&L Bulletins 96-02 and 96-25, and when the work is satisfactorily completed, we will provide letters of assurance covering the envelope elements we have reviewed. The field reviews will be carried out at intervals appropriate to the stage of construction which we consider necessary to determine if the work is in general conformity with the approved construction documents. However we are not required to make exhaustive or continuous on-site reviews. We will report to the Contractor, Developer/Owner and the Quality Management Representatives of the Designers/ Builders/ Suppliers and/or Installers as appropriate as to deficiencies in the work observed during the course of field reviews. Reviews conducted by us are for the following purposes: 1) to examine, evaluate and report to you upon representative samples of the work; any comments on the balance of the work made during the course of the field reviews are assumptions based on extrapolation; 2) to determine if the work is in general conformity with Part 5 of the [Vancouver Building Bylaw and City of Vancouver Bulletins 96-02 and 96-25] [B.C. Building Code], copies of which are to be kept on the construction site. Deficiencies identified in field reviews are to be promptly corrected in accordance with our recommendations. Our final certification will only be provided when we are satisfied that remedial work has been satisfactorily completed.

All project participants are asked to keep the Building Envelope Reviewer role in mind as they perform their services. Feel free to consult us as regards problems/issues arising in the course of construction.

2. BUILDING ENVELOPE STRATEGY:

The following was agreed as a suitable strategy for managing water for this project:

2.1 Thermal Resistance of Assemblies -

It is the responsibility of the Designers to obtain approvals from the city's Energy Utilization Department. The Building Envelope Reviewer will rely upon the soils report for the determination of subsurface information.

Products and assemblies which require particular attention as regards their thermal resistance include the following: [hereafter some samples]:

Metal framed glazed assemblies separating interior conditioned spaces from exterior or unconditioned spaces and requiring a thermal break include: (Those double asterisked (**) are required to have a fire resistance rating, hence do not require a thermal break)

•

Conductive components penetrating the building envelope, and the proposed/ recommended method(s) to minimize condensation, include:

•

2.2 Air Barrier Systems

The air barrier system(s) proposed/recommended for the project, and measures to ensure continuity, include:

•

To ascertain that wood structural members and structural sheathing do not exceed 19% moisture content prior to installing the air barrier system, we propose the following:

•

2.3 Vapour Barriers

The vapour barrier system(s) proposed/recommended for the project, and measures to ensure continuity, include:

•

To ascertain that wood structural members do not exceed 19% moisture content prior to installing the air barrier system, we propose the following:

•

2.4 Protection from Precipitation -

Rain water can be expected to impact the project building[s] as follows: [Describe the path of rainwater from areas of impact to drainage, noting where design details such as overhangs will reduce impact, and in particular areas where there are discontinuities in the handling of water.]

The following measures are proposed/recommended to minimize the ingress of precipitation into assemblies and components:

•

The following measures are proposed/recommended to prevent the ingress of precipitation into interior spaces:

•

The following measures are proposed/recommended to drain moisture to the exterior:

•

2.5 Sealing, Drainage, Accumulation and Disposal -

The following measures are proposed/recommended to shed precipitation and drain moisture to the exterior:

•

2.6 Protection from Surface Water -

Ground water from off site [will be generally directed away from the subject site by [list devices]] [may be expected to enter the site [list locations] and will flow through the site by [list devices]]

2.7 Foundation and Floor Drainage [Verify that the design includes suitable foundation drainage.]

2.8 Protection from Moisture in the Ground

3. TENDERING:

[Company Logo] [Company address] [Company tel/fax/e-mail] **QMR Rep:** **Tel/ fax/ e-mail:**	**BUILDING ENVELOPE DESIGN REVIEW MEETING** **Date:** **Project Name:** **Project Address:**

3.1. ACTION ARCHITECT/CONTRACTOR - Copy the Building Envelope Reviewer with documentation re proposed alternative products or substitutions relating to the building envelope, to allow the Building Envelope Reviewer to review compliance with the water management strategy.

4. CHANGES:

4.1. ACTION ARCHITECT/CONTRACTOR - Copy Building Envelope Reviewer with documentation re proposed Changes to the Work, RFI's, Site Instructions, etc., relating to the building envelope, to allow Building Envelope Reviewer to review compliance with the water management strategy. Use the "Submittal Review" form for this purpose.

9. SUBMITTALS AND FIELD REVIEWS:

9.1. ACTION CONTRACTOR - Building Envelope Reviewer to receive manufacturers' literature describing proposed materials and systems of trades noted below. Allow Building Envelope Reviewer 48 hours for review and comment back, as regards timing for ordering of materials. Building Envelope Reviewer to receive construction schedule and be advised minimum 48 hours in advance of commencement of work of following trades:

- Membrane waterproofing
- Deck/ balcony waterproofing
- Roofing
- Peel & Stick membranes
- Building paper/ air barriers
- Cladding
- Windows, doors and skylites - shop drawings required, including associated flashing
- Mechanical penetrations (vents, ducts, flues, etc.) through horizontal and vertical envelope - shop drawings or manufacturer's literature required, including associated flashing
- Exterior handrails and guardrails - shop drawings required

A sample Building Envelope Field Review Report is attached for reference and as an indication of the scope of field reviews required for the project.

10. OCCUPANCY/COMPLETION:

10.1. Currently scheduled occupancy date: _____
10.2 It is understood that the Building Envelope Reviewer will not be able to provide an assurance letter regarding the building envelope until remedial work requested during field review has been completed.

NOTES:
1. These minutes are prepared as part of the Building envelope services for this project, as required by the municipality. Copies may be distributed to the municipality. Contractor, please distribute to appropriate subcontractors and suppliers. Report any discrepancies to the writer within 5 working days of the meeting date or all items will be assumed to be correct. E&OE.
2. Attention to the item(s) with the notation "SEE NOTE 2 BELOW" will involve additional services by the Building Envelope Reviewer, which will be charged in accordance with our contract agreement.

---

1 NOTE: The content of this meeting template has not been reviewed in detail by legal counsel.

[Company Logo] [Company address] [Company tel/fax/e-mail] **QMR Rep:** **Tel/ fax/ e-mail:**	**BUILDING ENVELOPE DESIGN REVIEW MEETING** **Date:** **Project Name:** **Project Address:**

[2] This is a typical scope of services which will vary depending upon the Reviewer's services contract. Note that, at the moment, there is no mandatory scope of services.

[3] Wording for projects in Vancouver

[4] Again, the attendees are a function of the Reviewer's services scope and the state of the Project.

[5] here, reference should be made to the Best Practices Guide

[Company Logo] [Company address] [Company tel/fax/e-mail] **QMR Rep:** **Tel/ fax/ e-mail:**	**SUBMITTAL REVIEW** **Project Name:** **Project Address:** **Customer Name:** **Customer Address:** **Customer Tel/fax/e-mail:** **Customer QMR Rep.:** **QMR Rep. tel/ fax/ e-mail**

This form must be completely filled in with all relevant data and submitted to the Building Envelope Reviewer for consideration. Where an alternative or substitution is requested: a) the proposal may be rejected if it is incomplete or unclear; b) any additional costs to the Project a to be borne by the applicant, including redesign costs; c) any anticipated reduction in costs to the Project shall entitle the Owner to an appropriate credit.

SUBMISSION/SCHEDULING DATA:

DATE SUBMITTED: _____ DATE RECEIVED BY REVIEWER: _____

DATE by which response is required to maintain contract schedule: _____
SUBMITTAL MADE BY: ☐ Same as header above left ☐ OTHER (Specify name & Contact Information):

PURPOSE OF THIS SUBMITTAL:

☐ SUPPORTING TENDER ☐ SUPPORTING REQUEST FOR ALTERNATIVE OR SUBSTITUTION
☐ FOR REVIEW PRIOR TO FABRICATION AND/OR INCORPORATION INTO THE PROJECT
☐ OTHER (Specify:

CONTENT OF THIS SUBMITTAL (Check all appropriate boxes):

☐ PROPOSED PRODUCTS LIST ☐ SHOP DRAWINGS ☐PRODUCT DATA ☐ SAMPLES ☐WARRANTY

For a proposed alternative/substitution, attach the following information as a minimum:
1. Manufacturer's technical data sheets re proposed products
2. Manufacturer's standard form of warranty proposed for this project
3. Letter on manufacturer's letterhead stating that the manufacturer will warrant the products as proposed.
4. Letter(s) from Suppliers and Installers responsible for the works affected by the proposed alternative/substitution which state the total cost(s) of any alteration work they will require to do to accommodate the proposed alternative/substitution.

FILL IN THE REMAINING PORTIONS FOR A PROPOSED ALTERNATIVE OR SUBSTITUTION:
ALTERNATIVE/SUBSTITUTION REQUESTED IS FOR:
☐ Named product ☐ Product type, material, finish or formulation ☐ Fabrication or installation methods

☐ Other (Specify):_____

REASON FOR REQUEST:_____
The product/ material/ method for which an alternative/substitution is requested is shown on the following documents:

Specification Section #: _____ Page(s) _____ Clause No(s): _____

Drawings: (List Drawings Nos. and Detail Nos. affected):

Describe in detail any alteration to any other part of the Project required by use of the requested alternative/substitution:

[Company Logo] [Company address] [Company tel/fax/e-mail] **QMR Rep:** **Tel/ fax/ e-mail:**	**SUBMITTAL REVIEW** **Project Name:** **Project Address:**

Total net cost or credit for any such other required alteration, including overhead & profit:	$
Cost of builder's administration (to be filled in by Builder):	$
Cost of Designer's documentation & administration (to be filled in by affected Designers):	$
Total cost of such alterations (to be filled in by Designer):	$
Total cost savings achieved (from following data, to be filled in by Designer):	$
Total cost/benefit to Owner (to be filled in by Designer):	$

Benefits to Owner other than financial:

Fill in the following as applicable to the product, material or method proposed for alternative/ substitution. If the item is mentioned in the Specification as a performance or material requirement, then information about the proposed alternative/substitution is required by the Designer to evaluate the proposal. Requests lacking sufficient information will be returned without action.

Specified product, material or method:	**Proposed alternative/ substitution:**
Description:	Description:
Product name:	Product name:
Type:	Type:
Model No.:	Model No.:
Thickness(es):	Thickness(es):
Composition:	Composition:
Adjacent specified materials (List):	Compatibility with adjacent specified materials ☐Yes ☐No If NO, specify proposed solution:
Resistance to chemical(s) (list):	Resistance to chemical(s) (list):
Thermal resistance (specify units):	Thermal resistance (specify units):
Vapour resistance ((Pa x sq.m.)/ng): LOWrh: HIGHrh:	Vapour resistance ((Pa x sq.m.)/ng): LOWrh: HIGHrh:
Density (kg/cu.m):	Density (kg/cu.m):
Moisture content (kg/sq.m.): @100%rh: saturated:	Moisture content (kg/sq.m.): @100%rh: saturated:
Substrate preparation req'd:	Substrate preparation req'd:
Availability (time):	Availability (time):
Country of manufacture:	Country of manufacture:
Applicable Cdn codes/stds. ☐ (Specify stds. met)	Meets applicable Cdn codes/stds. ☐ Yes ☐ No (Specify stds. met)
Length of warranty: available: proposed:	Length of warranty: available: proposed:

[Company Logo] [Company address] [Company tel/fax/e-mail] **QMR Rep:** **Tel/ fax/ e-mail:**	**SUBMITTAL REVIEW** **Project Name:** **Project Address:**

Other specifid performance criteria:	Other specifid performance criteria:
Unit cost of product/material (must be completed):	Unit cost of product/material (must be completed):
$_____ per Unit _____	$_____ per Unit _____
Units req'd _____ Total value $_____	Units req'd _____ Total value $_____

I certify that I have checked the above documentation for the proposed alternative/substitution and warrant it to be substantially complete and accurate:
(Signature of proponent): Date:

STATUS OF SUBMITTAL REVIEW:

☐ REVIEWED ☐ REVIEWED AS NOTED ☐ REVISE & RESUBMIT ☐ REJECTED

REVIEWER: Date:

COMMENTS:

LIMITATIONS OF SUBMITTAL REVIEW: This review is for the sole purpose of ascertaining conformance to sound principles of building envelope science as well as to the applicable building bylaws, codes and applicable municipal policies and to the design intent. This review does not guarantee that the proposed design and subsequent construction contain no aspects which might contravene sound building envelope science principles. This review shall not mean that Building Envelope Reviewer approves or warrants the detail design of others or the design inherent in shop drawings, manufacturer's literature or material and system samples, responsibility for which shall remain with the Designers, Builders, Suppliers and/or Installers submitting same. This review shall not relieve the Designers, Builders Suppliers and/or Installers of their responsibility for errors or omissions in drawings, specifications, shop drawings or manufacturer's literature or of their responsibility for meeting all requirements of the Contract Documents and applicable building codes and regulations. The Contractor is responsible to confirm and correlate dimensions, for information that pertains solely to fabrication processes or for techniques of construction and installation and for the work of all subtrades. E&OE

[Company Logo] [Company address] [Company tel/fax/e-mail]	**Purchase Order #**	
	Project No.	
	Cost Code No.	
	Date Issued:	
	Date Required at Project:	
Purchase Order to (Supplier/Installer):	**Ship to: ☐ Project ☐Other:**	
	Project Name:	
	Project Address:	
Contact Name:	**Contact Name:**	
Contact Tel./fax:	**Contact Tel./fax:**	

For the above-noted project, to provide lanour, material, equipment and supervision necessary for:
☐ Supply only ☐Supply and installation of (Describe work):

[Insert work/material/product description here]

Work of this Contract includes, but is not necessarily limited to, the attached Scope of Work (Supplier/Installer to initial)

	TOTAL CONTRACT VALUE Provincial Sales Tax (P.S.T.) is included. Goods and Services Tax (G.S.T.) is not included.	**$**
☐In accordance with drawings (List):	Dwg. title(s)	Issue date:
☐In accordance with specifications prepared by (List Designer and spec title(s)):	Specifications title(s):	Issue date:
☐In accordance with the Submittal Review dated:	Submittal Review date:	(Copy of Submittal Review attached and initialed by the Supplier/Installer)
☐In accordance with your Quotation dated:	Quotation date:	(Copy of Quotation attached and signed/ initialed by the Supplier/Installer)

We hereby agree to perform the work and supply the materials, labour, service and equipment necessary therefore on the terms and conditions det out herein and on the back of this Purchase Order:	Accepted by: [Insert Project Company Name]
per _____	per _____ (Authorized Signatory)
Title_____	Title _____Tel/fax/e-mail _____
The Quality Management Representative for us on this Project is:	The Quality Management Representative for us on this Project is:
_____ (Print Name)	_____ (Print Name)
_____ (Tel/fax/e-mail)	_____ (Tel/fax/e-mail)

FIELD REVIEW REPORT

Company Logo

DATE

TO/PRESENT:

REF #

PROJECT:

PER:

ACTION BY
C = CONTRACTOR
A = ARCHITECT
S = STRUCTURAL
M = MECHL.
E = ELECTL.
L = L'SCAPE
CP = CERT. PROF.
ABES = APPD. BLDG. ENV. SP.

The following are comments regarding progress of the work and compliance with applicable codes, bylaws and the contract documents. The contractor shall promptly correct deficient work and notify the signator of this report for reinspection when ready. The contractor remains responsible for the correction of deficient work, whether stated herein or not. E&OE.

WEATHER: TEMP. VIA: ☐ MAIL ☐ COURIER ☐ FAX ☐ HAND

[Address] - Tel [ ] Fax [ ]
e-mail: [ ]

COPIES TO: ☐ SITE ☐ ARCHITECT ☐ OWNER ☐ CONTRACTOR ☐ OTHERS:

Page ___ of ___

Due	Compl.	☑ = acceptable; ⊛ = correction req'd before proceeding; ☒ = not accepted - correct and call for reinspection;	Action by
☐	☐		
☐	☐		
☐	☐		
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☐	☐		
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☐	☐		
☐	☐		

Company Logo

FIELD REVIEW REPORT - Air Barrier

DATE

TO/PRESENT:

REF #

PROJECT:

PER:

ACTION BY
C = CONTRACTOR
A = ARCHITECT
S = STRUCTURAL
M = MECHL.
E = ELECTL.
L = L'SCAPE
CP = CERT. PROF.
ABBR = APPD. BLDG. ENV. SP.

The following are comments regarding progress of the work and compliance with applicable codes, bylaws and the contract documents. The contractor shall promptly correct deficient work and notify the signator of this report for reinspection when ready. The contractor remains responsible for the correction of deficient work, whether noted herein or not. EAOE.

WEATHER: TEMP. VIA: ☐ MAIL ☐ COURIER ☐ FAX ☐ HAND

[Address] - Tel [ ] Fax [ ]
e-mail: [ ]

COPIES TO: ☐ SITE ☐ ARCHITECT ☐ OWNER ☐ CONTRACTOR ☐ OTHERS:

Page ___ of ___

Due	Compl.	☑ = acceptable; ✱ = correction req'd before proceeding; X = not accepted - correct and call for reinspection;	Action by
☐	☐	Location(s) reviewed :	
☐	☐	Specified Strapping material :	
☐	☐	Specified air barrier material :	
☐	☐	Specified lap seal method? :	
☐	☐	Continuity at low slope interfaces? (<1:12) :	
☐	☐	Continuity at higher slope interfaces? (>1:12, e.g., gable roof/wall) :	
☐	☐	Continuity at openings? :	
☐	☐	Strapping covers fasteners? :	
☐	☐	Strapping fasteners? :	
☐	☐	Screening of drainage cavities? :	
☐	☐	Strapping spacing? (max. 16" for Tyvek):	
☐	☐	Additional comments :	
☐	☐	Okay to cover air barrier? : ☐ Yes ☐ No ☐ Comments:	

Company Logo

FIELD REVIEW REPORT - Ins./V.B.

DATE

TO/PRESENT:

REF #

PROJECT:

PER:

ACTION BY
C = CONTRACTOR
A = ARCHITECT
S = STRUCTURAL
M = MECHL.
E = ELECTL.
L = L'SCAPE
CP = CERT. PROF.
ABBR = APP'D. BLDG. ENV. SP.

The following are comments regarding progress of the work and compliance with applicable codes, bylaws and the contract documents. The contractor shall promptly correct deficient work and notify the signator of this report for reinspection when ready. The contractor remains responsible for the correction of deficient work, whether stated herein or not. E&OE.

WEATHER: TEMP. VIA: ☐ MAIL ☐ COURIER ☐ FAX ☐ HAND

[Address] - Tel [ ] Fax [ ]
e-mail: [ ]

COPIES TO: ☐ SITE ☐ ARCHITECT ☐ OWNER ☐ CONTRACTOR ☐ OTHERS:

Page ___ of ___

Due	Compl.	✔ = acceptable; ± = correction req'd before proceeding; X = not accepted - correct and call for reinspection:	Action by
☐	☐	Location(s) reviewed :	
☐	☐	Reference details :	
☐	☐	Insulation Material(s) used : :	
☐	☐	☐ Continuity & thickness @ corridor walls :	
☐	☐	☐ Continuity & thickness @ party walls :	
☐	☐	☐ Continuity & thickness @ exterior walls :	
☐	☐	☐ Continuity & thickness @ exterior wall opngs. :	
☐	☐	Additional Comments - Insulation :	
☐	☐	Exceptions - Insulation :	
☐	☐	Vapour Barrier Material(s) used :	
☐	☐	☐ Continuity at floors:	
☐	☐	☐ Continuity at walls:	
☐	☐	☐ Continuity at ceilings:	
☐	☐	☐ Continuity at opngs.:	
☐	☐	☐ Continuity with air barrier, generally:	
☐	☐	☐ Continuity with air barrier at windows.:	
☐	☐	Additional comments - vapour barrier:	
☐	☐	Exceptions - vapour barrier:	
☐	☐	Okay to cover ? : ☐ Yes ☐ No ☐ Comments:	

Company Logo

FIELD REVIEW REPORT - Opng. Prep.

DATE

TO/PRESENT:

REF #

PROJECT:

PER:

ACTION BY
C = CONTRACTOR
A = ARCHITECT
S = STRUCTURAL
M = MECHL.
E = ELECTL.
L = L'SCAPE
CP = CERT. PROF.
ABBR = APPD. BLDG. ENV. SP.

The following are comments regarding progress of the work and compliance with applicable codes, bylaws and the contract documents. The contractor shall promptly correct deficient work and notify the signator of this report for reinspection when ready. The contractor remains responsible for the correction of deficient work, whether stated herein or not. E&OE

WEATHER:

TEMP.

VIA: ☐ MAIL ☐ COURIER ☐ FAX ☐ HAND

[Address] - Tel [ ] Fax [ ]

e-mail: [ ]

COPIES TO: ☐ SITE ☐ ARCHITECT ☐ OWNER ☐ CONTRACTOR ☐ OTHERS:

Due	Compl.	✔ = acceptable; ✱ = correction req'd before proceeding; X = not accepted - correct and call for reinspection;	Action by
☐	☐	Location(s) reviewed :	
☐	☐		
☐	☐	Reference details :	
☐	☐		
☐	☐	Opng. properly frames/placed (min. 1980mm (6'-6") @ door headers):	
☐	☐		
☐	☐	Starter strip of W/barrier +/-1" below opng. :	
☐	☐		
☐	☐	Priming for peel & stick :	
☐	☐		
☐	☐	Sill membrane up jambs 8" min.:	
☐	☐		
☐	☐	Gusseted corners:	
☐	☐		
☐	☐	Proper lapping of opng. prep.:	
☐	☐		
☐	☐	Proper lapping of opng. prep.:	
☐	☐		
☐	☐	Spaced strapping at sill:	
☐	☐		
☐	☐	Additional comments:	
☐	☐		
☐	☐		
☐	☐		
☐	☐		
☐	☐		
☐	☐		
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☐	☐		
☐	☐		
☐	☐	Okay to cover rough opening? : ☐ Yes ☐ No ☐ Comments:	
☐	☐		

Company Logo

SUMMARY OF PROJECT DEFICIENCIES

DATE: SEE BELOW

TO: THOSE NOTED BELOW

REF #

[illegible]

PROJECT:

PER:

VIA: ☐ MAIL ☐ COURIER ☐ FAX ☐ HAND

The comments below are a summary of deficiencies observed during field reviews, at Project meetings, in correspondence and in reviewing submittals. Required action is indicated, together with responsibility and dates due where known. The Contractor remains responsible for the correction of deficient work, whether stated herein or not. E & OE.

[Address] - Tel [ ] Fax [ ]
e-mail: [ ]

COPIES TO: ☑ SITE ☑ ARCHITECT ☑ OWNER ☑ CONTRACTOR ☐ OTHERS:

ACTION BY
C = CONTRACTOR
A = ARCHITECT
S = STRUCTURAL
M = MECHL.
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CP = CERT. PROF.
ABES = APPD. BLDG. ENV. SP.

Page ___ of ___

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Doc #	Description	Appr by:	a	b	c	d	e	f	g	h	

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Helping to house Canadians.

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CONTROLLED DOCUMENT STAMP

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Copy Number	
Controlled Copy	YES ☐ NO ☐

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INSPECTION EQUIPMENT CALIBRATION RECORD

EQUIPMENT IDENTIFICATION NO.							CALIBRATION INTERVAL WEEKS/MONTHS/YEARS	

DESCRIPTION		RANGE:	UPPER:
MANUFACTURER			
DATE RECEIVED:			LOWER:
LOCATION			

DATE INSPECTED	PROCEDURE OR STANDARD	INSPECTION RESULTS			REMARKS	INSPECTED BY	DATE DUE

Page _____

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INSPECTION EQUIPMENT LOG AND CALIBRATION SCHEDULE

I.D. NO.	EQUIPMENT DESCRIPTION	ISSUED TO: LOCATION:	MONTH												COMMENTS
			JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	

Page:

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INSPECTION EQUIPMENT CALIBRATION LABEL

CALIBRATION ☐ VERIFICATION ☐	
Equipment I. D.	
Calibrated by (initials):	Next calibration due: ___/___/___

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"HOLD" TAG LOG

HOLD TAG #	DATE ISSUED	PRODUCT IDENTIF.	DESCRIPTION OF NONCONFORMANCE	WORK ORDER #	HOLD TAG STATUS	COMMENTS I.E. PRODUCT LOCATION, ETC.
	___ / ___ / ___					
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	___ / ___ / ___					

Status Codes: H - Hold B - Reject / Return U - Use R - Rework I - Inspect
S - Scrap

PAGE: _____

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HOLD TAG

CMHC SCHL	HOLD TAG #_____		HOLD TAG #_____
Supplier / Subcontractor			Date: _____/_____/_____
Product / Component / Service:	Quantity:	Date: ___/___/___	Location
Reason for "HOLD": _____ _____ _____ _____ _____ _____ Originated by:_____ (initials) CAR# (if applicable):_____	Disposition (circle): HOLD REJECT / RETURN USE REWORK INSPECT SCRAP Authorized by:_____ (initials)		Reason for "HOLD": _____ _____ _____ _____ _____ _____ _____ Please return this portion of "HOLD" Tag to the Quality Assurance Representative.